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those indicated by red arrows based on rawins taken at 0300 G. C. T.

CORRECTION

MONTHLY WEATHER REVIEW, December 1948, vol. 76, "North Atlantic Hurricanes and Tropical Disturbances of 1948," p. 228. In Table 8, Storm IX, lowest pressure reported should read "28.92 inches" instead of "29.92 inches."

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ESTIMATING THE PROBABILITY OF A LARGE FALL IN TEMPERATURE AT WASHINGTON, D. C.

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ABSTRACT

Three criteria based on the surface pressure distribution at 0130 E. S. T. are developed for large falls in temperature from the 0130 E. S. T. temperature to the minimum the following night. For those cases which meet all three criteria, charts are developed based on temperature gradients and pressure gradients which give probabilities of large falls in temperature ranging from less than 10 percent to greater than 90 percent. Forecasts are made for those cases in which the probability is 50 percent or greater, and compared with the official Weather Bureau forecasts for the same cases.

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INTRODUCTION

One purpose of this paper is to present and illustrate a particular type of technique, or approach, to a specific forecasting problem. The approach is based mainly upon the techniques developed and used by Brier in developing objective methods of forecasting the occurrence of precipitation at Washington, D. C. [1], and precipitation amounts in the TVA Basin [2]. Other investigators have used similar procedures on other forecasting problems. For example: Thompson [3], in forecasting precipitation amounts at Los Angeles, Vernon [4], in forecasting occurrence of precipitation 24 to 48 hours in advance at San Francisco, Penn [5], in forecasting precipitation amounts for Boston, and Palmer [6], in forecasting the direction of movement of low pressure centers.

The specific problem attacked in this investigation was the forecasting of large falls in temperature from one night to the next during the winter months at Washington, D. C. The objective has been to determine the synoptic situations which are most likely to be followed by a large drop in temperature and to develop a basis for probability statements regarding such an occurrence. This work has been a continuation of the research on minimum temperature forecasting at Washington, D. C., begun by the Weather Bureau in 1946. A report on the research conducted prior to the present work is contained in Weather Bureau Research Paper No. 27 entitled "Objective Methods of Forecasting Winter Minimum Temperatures at Washington, D. C.," by Conrad P. Mook and Saul Price.

At first glance there would seem to be no connection between the "Trajectory Method" as described by Mook and Price and the procedures outlined in the following pages, but the basic idea behind the "Trajectory Method" has been retained, if somewhat simplified. The "Trajectory Method" is a technique for forecasting the "source" of the surface air which will be over the station at the end of the forecast period. The procedures described in this report, however, do not attempt to forecast the exact source, but rather attempt to group into one class those situations in which advection is from the same general direction and which include as many as possible of the large drops in temperature.

The criteria for a large drop in temperature which were developed in this study were based on data from the winter months of January, February, and December of the years 1940 through 1943 inclusive and January and February 1944. Minimum temperatures for Washington, D. C., which occurred between 1930 E. S. T. and 0730 E. S. T. were obtained from Weather Bureau Forms 1001. All other temperature and pressure data were taken from the analyzed 0130 E. S. T. surface maps. A total of 414 cases were obtained from these 14 months. Data for seven days were not obtainable due to the 0130 E. S. T. maps being missing from the series used. The dates of these days are January 20 to 24 inclusive, 1940; December 1, 1940; and January 16, 1941. The data for these 414 cases or any portion of them will be referred to as "original" data.

Data from the twelve winter months of December 1944 through February 1948 were obtained from the same sources as above and reserved for test purposes. Data were available for every day in these months making a total of 361 cases. These data will be referred to as "test" data.

DEVELOPMENT OF CRITERIA FOR A LARGE DROP IN TEMPERATURE

As stated in the introduction, the primary objective was to determine the synoptic situations which are most likely to be followed by a large drop in temperature, and to develop a basis for probability statements regarding such an occurrence. For the purpose of this paper, a large change in temperature is defined as a change of 10 Fahrenheit degrees or more from 0130 E. S. T. one day to the minimum temperature occurring between 1930 E. S. T. and 0730 E. S. T. the following night. Depending upon the time of occurrence of the minimum, this constitutes an 18- to 30-hour forecast. In general the forecast is for 24 to 30 hours, since normally the minimum temperature occurs between 0130 E. S. T. and 0730 E. S. T. In what follows, a "10° drop" will mean a fall in temperature of 10° or greater. Similarly a "15° drop" will mean a fall in temperature of 15° or greater, and a "20° drop" a fall of 20° or greater.

In this study no attempt has been made to discover or introduce anything new into forecasting temperature changes. Instead, some of the more obvious things on the surface chart which every forecaster considers in making a temperature forecast have been combined systematically to arrive at a probability statement of the occurrence of a large drop in temperature.

Most large falls in temperature occurring in the middle latitudes result from distinct changes of air mass over the station. This implies the passage of a cold front. Approximately 90 percent of falls in temperature (as defined above) of 20° or greater which occur at Washington, D. C., result from a cold front passage. Changes of 10° to 20°, however, frequently result from a different type of situation. This is the case of a well developed low pressure center, usually an east coast cyclone, which passes to the south or east of the station with a subsequent influx of cold air from the north to northwest.

DEVELOPMENT OF CRITERION 1

Since the position of the low center with respect to the station is of primary importance in connection with a large change in temperature, whether a cold front is involved or not, the first variable investigated was the position of the point of lowest pressure which lay between 70° and 100° W, long., and 30° and 55° N. lat. on the 0130 E. S. T. surface charts. The temperature change as defined above was plotted on a base map of North America at the position of the lowest pressure within this area. While a definite separation of large positive and large negative changes could be detected, it was apparent from inspection of some of the surface maps for individual cases that the area chosen was much too large.

The area was therefore reduced to that bounded by the 75th and 95th meridians, and the 30th and 45th parallels of latitude. The point of lowest pressure within this area was then located and temperature changes plotted for only those cases in which the temperature change was plus or minus 10° F. or greater (fig. 1). In order to avoid bounding this area each time it is mentioned, it will henceforth be referred to simply as the "area."

Figure 1 shows a good discrimination between large negative and large positive changes, and is the basis of the first criterion for a large drop in temperature.

Criterion 1.—

The position of lowest pressure in an area bounded by the 75th and 95th meridians and the 30th and 45th parallels of latitude must be east or south of a line as indicated on figure 1.

In the 414 cases of original data there were 97 cases of 10° drops, or a probability of 0.23. By applying Criterion 1 the original 414 cases were separated into two groups in which the probability of a 10° drop in one group was 0.32 ($^{92}/_{292}$), and in the other only 0.04 ($^{5}/_{122}$). The second of these groups was then eliminated and only the 292 cases of the first group considered for further study.

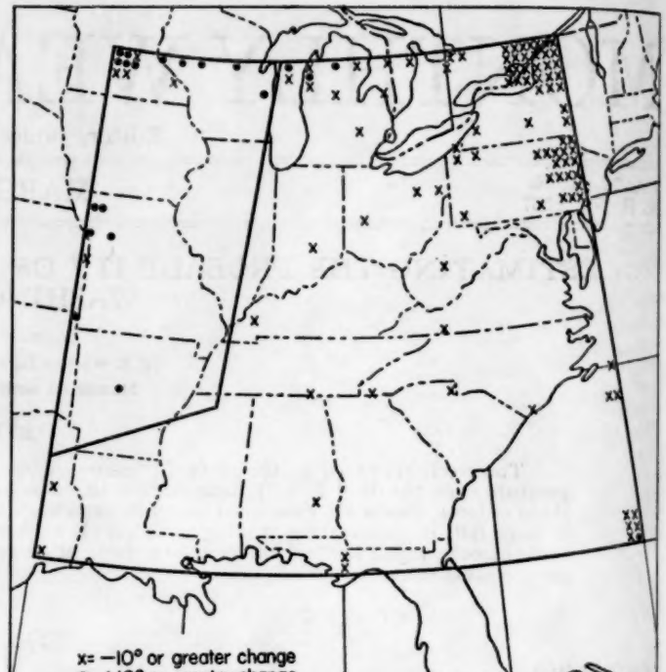

FIGURE 1.—Map showing position of lowest pressure in the area bounded by the 75th and 95th meridians and the 30th and 45th parallels of latitude for only those cases in which the change in temperature from 0130 E. S. T. to the minimum the following night was 10° F. or greater.

DEVELOPMENT OF CRITERION 2

Inspection of the 0130 E. S. T. surface charts after which a drop of 10° or more occurred, showed as was mentioned above, that in a large proportion of the cases the change was caused by a cold front passage at Washington. Furthermore, in nearly every case the cold front existed either between Norfolk, Va., and Chicago, Ill., or between Norfolk and Alpena, Mich., depending upon the orientation of the front. Usually the cold front was oriented in a northeast-southwest position, so that the front was between Norfolk and both Chicago and Alpena. Cases occurred, however, where the front was oriented in such a way that it lay between Chicago and Alpena, and thus existed only between Norfolk and Alpena, or only between Norfolk and Chicago, depending upon whether the front had an east-west or north-south orientation. A further distinction will be made between these two cases later. Norfolk was chosen as the eastern bounding position of the cold front instead of Washington itself to allow for those cases in which Washington was still in the transition zone of the front at 0130 E. S. T. and the initial large drop in temperature had not taken place. A front to the east of Norfolk was in general far enough to the east of Washington so that Washington was no longer in the transition zone.

A cold front as described above existed in 83 of the 292 cases which satisfied Criterion 1. Fifty-four, or 65 percent of these 83 cases resulted in a 10° drop in temperature. From these figures the first part of Criterion 2 was formulated: (*a*) A cold front must exist between Norfolk and Chicago, or between Norfolk and Alpena, Mich., depending upon the orientation of the front.

In the 209 cases in which no cold front existed it was found that the cases were distributed in such a way that 74 percent of the 10° drops occurred when the point of lowest pressure in the "area" fell south of 42½° N. A proportionally greater number of 10° drops occurred when the point of lowest pressure fell south of 42½° N. than when it fell north of 42½° N. This distribution is illustrated in table 1. From this distribution the second part of Criterion 2 was formulated: (*b*) If no cold front exists, the point of lowest pressure in the area must be south of 42½° N.

TABLE 1.—*Distribution of falls in temperature of 10° or greater with latitude of point of lowest pressure in the "area"*

Latitude of lowest pressure	Total cases		Number of 10° drops		Percent	
30-32	59		11		19	
33-34	16		3		19	
35-37	21	120	6	28	29	23
38-39	5		1		20	
40-42	19		7		37	
43-45	89		10		11	

As can be seen from table 1, in 89 cases the point of lowest pressure was north of 42½° N. of which 10 cases were 10° drops. The most successful variable found for further stratifying these 89 cases was the current 0130 E. S. T. temperature at Washington. Figure 2 shows a scatter diagram of temperature change plotted against the 0130 E. S. T. Washington temperature. In 8 of the 10 cases which had a drop of 10° the Washington temperature was 40° F. or greater, while in only 6 of the 79 cases which had less than a 10° fall was the Washington temperature 40° or greater. From this chart the third part of Criterion 2 was formulated: (*c*) If no cold front exists and the point of lowest pressure in the "area" is north of 42½° N. the 0130 E. S. T. Washington temperature must be greater than 39° F.

The three parts are assembled to form the second criterion for a large drop in temperature at Washington, D. C.

Criterion 2.—

(*a*) A cold front must exist between Norfolk and Chicago, or between Norfolk and Alpena, Mich., depending upon the orientation of the front.

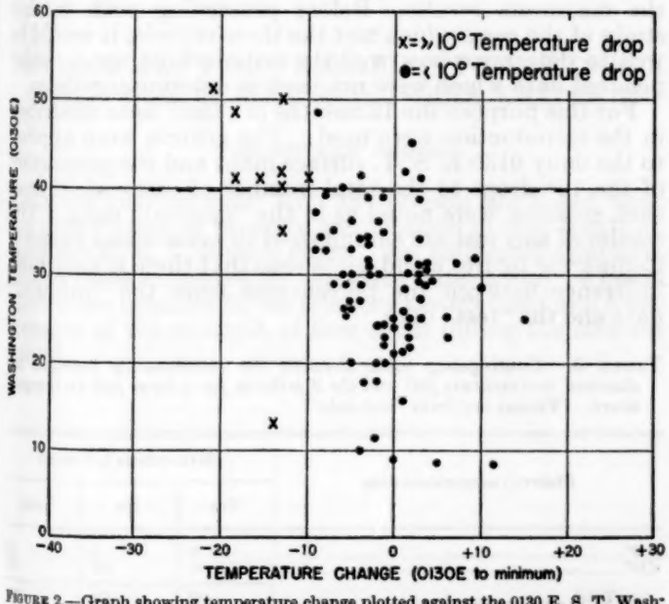

FIGURE 2.—Graph showing temperature change plotted against the 0130 E. S. T. Washington temperature for all cases which satisfied Criterion 1, and in which the point of lowest pressure in the "area" was north of 42½° latitude, and in which no cold front existed between Norfolk and Chicago, or between Norfolk and Alpena, Mich.

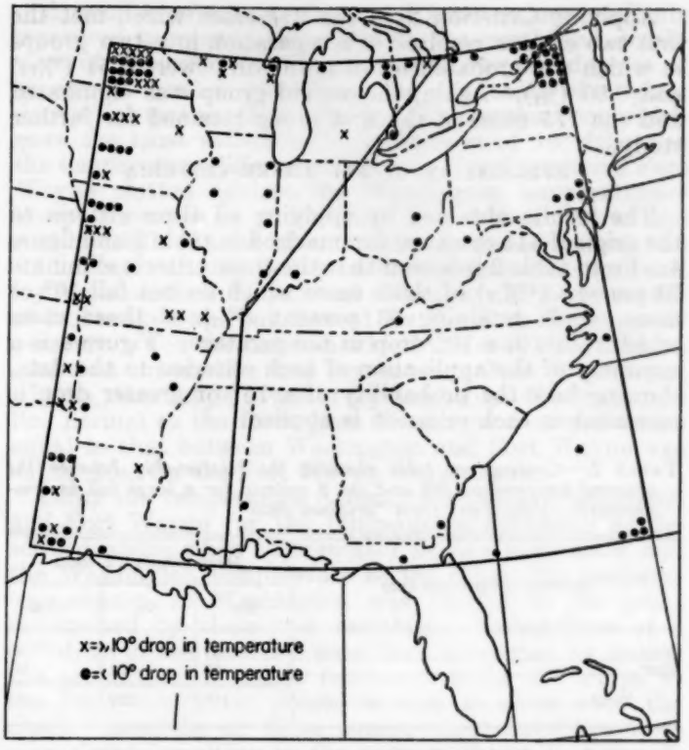

FIGURE 3.—Map showing position of highest pressure in the "area" for all cases which met Criteria 1 and 2, but in which no cold front existed between Norfolk and Chicago or between Norfolk and Alpena.

(*b*) If no cold front exists, the point of lowest pressure in the area described in Criterion 1 must be south of 42½° N. latitude.

(*c*) If no cold front exists, and the point of lowest pressure is north of 42½° N. latitude, the 0130 E. S. T. temperature at Washington must be greater than 39° F.

Criterion 2 applied to the 292 cases which satisfied the first criterion resulted in a separation into two groups in which the probability of a 10° drop in one was 0.41 (⁹⁹⁄₂₁₇), and only 0.03 (⅗) in the other. Here again the second group was eliminated and only the 217 cases which met both criteria were retained for futher study.

DEVELOPMENT OF CRITERION 3

To obtain further criteria for a drop of 10° or more, the point of highest pressure in the "area" was examined. In using this variable, it was found that better results could be obtained by again separating the cases according to whether or not a cold front existed as described under Criterion 2. The position of highest pressure in the "area" did not show a significant separation of 10° drops from other cases in the "cold front" cases. This variable did, however, eliminate a large proportion of cases which did not drop 10° from the "no cold front" cases. Figure 3 shows the temperature change plotted at the point of highest pressure in the "area" for only those cases which met the first two criteria, but in which no cold front existed between Norfolk and Chicago or between Norfolk and Alpena.

The third criterion for a large drop in temperature was then formulated from this chart.

Criterion 3.—

(*a*) Same as Criterion 2 (*a*).

(*b*) If no cold front exists, the point of highest pressure in the area described under Criterion 1 must be west of the line drawn on figure 3.

Applying Criterion 3 to the 217 cases which met the first two criteria resulted in a separation into two groups in which the probabilities of a 10° drop were 0.51 ($^{90}/_{175}$) and 0.00 ($^{0}/_{42}$). Again, the second group was eliminated and the 175 cases of the first group retained for further study.

APPLICATION OF ALL THREE CRITERIA

The results obtained by applying all three criteria to the original 414 cases are summarized in table 2 and figure 4. From table 2 it is seen that the three criteria eliminate 73 percent ($^{232}/_{317}$) of those cases which do not fall 10° or more, while retaining 93 percent ($^{90}/_{97}$) of those cases which result in a 10° drop in temperature. Figure 4 is a summary of the application of each criterion to the data, showing how the probability of a 10° or greater drop is increased as each criterion is applied.

TABLE 2.—*Contingency table showing the relationship between the observed temperature fall and the 3 criteria for a large fall in temperature. Values are from "original data"*

Observed temperature drop	Meets criteria 1, 2, and 3		
	Yes	No	Total
≥10°	90	7	97
<10°	85	232	317
Total	175	239	414

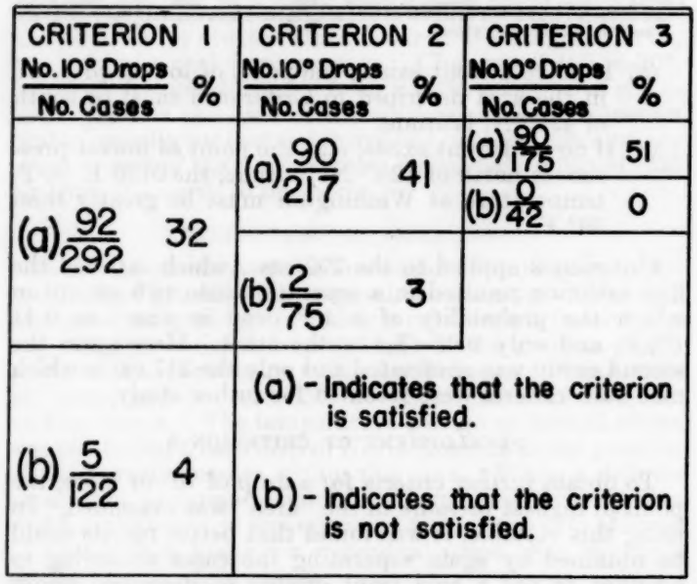
CRITERION 1
No. 10° Drops / No. Cases %
(a) 92/292 32
(b) 5/122 4
CRITERION 2
No. 10° Drops / No. Cases %
(a) 90/217 41
(b) 2/75 3
CRITERION 3
No. 10° Drops / No. Cases %
(a) 90/175 51
(b) 0/42 0
(a) - Indicates that the criterion is satisfied.
(b) - Indicates that the criterion is not satisfied.

FIGURE 4.—Table illustrating how the probability of a large fall in temperature is increased as each criterion is applied to the cases which satisfied the previous criterion. Values are from "original" data.

At this point it might be recalled that one of the purposes of the foregoing procedures was to group into one class those situations in which the advection of air into Washington was from the same general direction, while at the same time including as many as possible of the large falls in temperature. As shown above, the procedure retains 93 percent of the large drops. Figure 5 shows the distribution of the temperature changes in the 175 cases of original data which met all three criteria. In 90 percent of the cases (157/175) there was a drop in temperature, while in only 10 percent (18/175) was the change zero or a rise in temperature. Better methods of determining whether cold air advection occurred might be devised, but if the assumption is made that a drop in temperature,

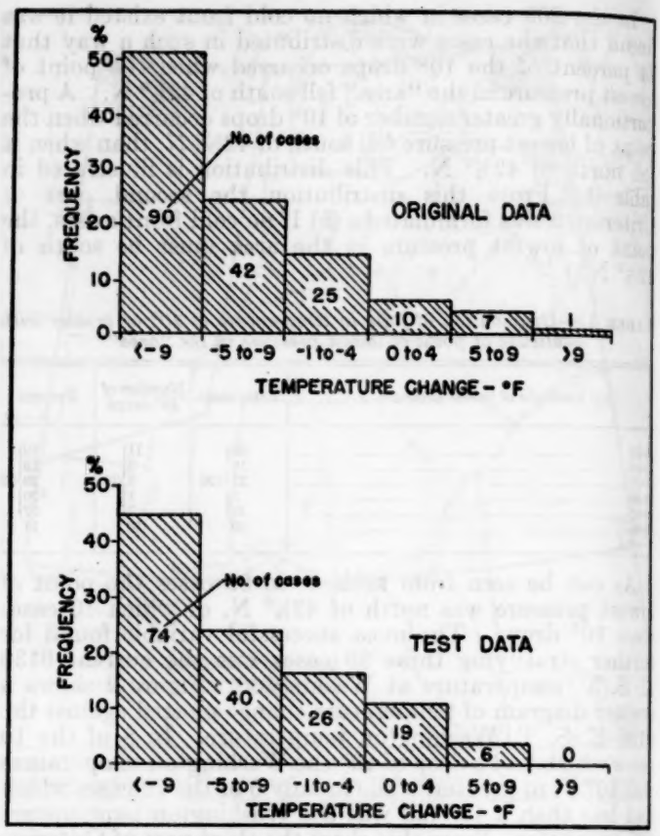

FIGURE 5.—Chart showing frequency distributions of temperature change from 0130 E. S. T. to the minimum the following night in those cases which satisfied all three criteria for a large fall in temperature.

regardless of magnitude, indicates cold air advection, in general from a northwesterly direction, this distribution indicates that cold advection took place in a large majority of the cases.

TEST OF CRITERIA ON INDEPENDENT DATA

Obviously, the results presented thus far could be expected to be good since the charts upon which the criteria were based were drawn in such a way as to give the maximum results. Before proceeding with further study of the cases which met the three criteria, it would be well to determine how well the criteria hold up on independent data which were not used in determining them.

For this purpose the 12 months of "test" data described in the introduction were used. The criteria were applied to the daily 0130 E. S. T. surface maps and the proportion of the 10° drops to the total number of cases which met each criterion were noted as in the "original" data. The results of this test are summarized in table 3 and figure 6. Comparing figures 6 and 4 it is seen that there is very little difference between the percentages from the "original" data and the "test" data.

TABLE 3.—*Contingency table showing the relationship between the observed temperature fall and the 3 criteria for a large fall in temperature. Values are from "test data"*

Observed temperature drop	Meets criteria 1, 2, and 3		
	Yes	No	Total
≥10°	74	9	83
<10°	91	187	278
Total	165	196	361

Table 3 shows that of the 361 cases of "test" data, 83 or 23 percent had a drop in temperature of 10° or greater—the same percentage as in the "original" data. Of the 278 cases that did not have a 10° drop, 187 or 67 percent were eliminated as compared with 73 percent in the "original" data. Of the 83 cases which had a drop of 10°, 74 or 89 percent met the three criteria, as compared with 93 percent in the original data. Application of the three criteria to the 361 "test" cases results in a sample of 165 cases in which the probability of a 10° drop is 45 percent, as compared with the climatological probability of 23 percent.

From the standpoint of whether the criteria group together cases in which the advection is that of cold air, the distribution of temperature changes in the 165 test cases which met all three criteria show that 85 percent (140/165) had falls in temperature, while only 15 percent (25/165) had zero change or a rise in temperature. This distribution is shown in figure 5.

CRITERION 1	CRITERION 2	CRITERION 3
No. 10° Drops / No. Cases = %	No. 10° Drops / No. Cases = %	No. 10° Drops / No. Cases = %
(a) 80/252 = 31	(a) 77/196 = 39	(a) 74/165 = 45
		(b) 3/31 = 9
	(b) 3/56 = 5	
(b) 3/109 = 4	(a) - Indicates that the criterion is satisfied.	
	(b) - Indicates that the criterion is not satisfied.	

FIGURE 6.—Table illustrating how the probability of a large fall in temperature is increased as each criterion is applied to cases which satisfied the previous criterion. Values are from "test" data.

DEVELOPMENT OF PROBABILITY CHARTS FOR CASES WHICH MET ALL THREE CRITERIA

TEN-DEGREE DROPS

Except for Criterion 2(c), the criteria are based upon the distribution of pressure and location of cold fronts on the 0130 E. S. T. surface chart. An additional stratification of cases which satisfy the three criteria may be based upon some measure of the temperature gradient and some measure of the strength of flow of air during the forecast period.

A number of temperatures and temperature gradients measured in various directions to the north and northwest of Washington were tried with varying degrees of success in further stratifying the 175 cases of original data which met the three criteria. The combination which gave the most satisfactory distribution of 10° falls was the temperature difference between Washington and Fort Wayne plotted against the Washington temperature—except for cases in which Fort Wayne was just to the east or south of a cold front. For the cases in which the cold front was oriented in a north-south direction and lay between Fort Wayne and Chicago, the temperature at Milwaukee was substituted for the Fort Wayne temperature. For the cases in which the cold front had an east-west orientation and lay between Fort Wayne and Alpena, the temperature at a point behind the front on a line normal to the front from Washington, at a distance equal to that between Washington and Fort Wayne was substituted for the Fort Wayne temperature.

Using the temperature difference between Washington and Fort Wayne (or the temperature difference as described above when appropriate) as one coordinate and the Washington temperature as the other, the temperature change at Washington was plotted at the point determined by these two variables. Probabilities of a 10° drop in temperature were then computed by noting the proportion of points representing the 10° drops to the total number of points in various areas over the chart. Isopleths of these computed probabilities were then drawn resulting in the pattern shown in figure 7.

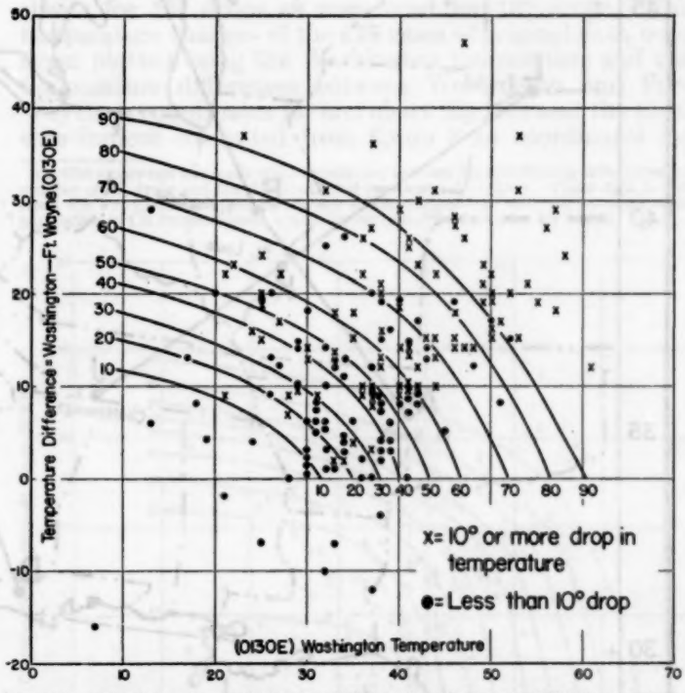
Temperature Difference=Washington—Ft. Wayne (0130E)
(0130E) Washington Temperature
x= 10° or more drop in temperature
●= Less than 10° drop

FIGURE 7.—Graph showing isopleths of probability of a 10° or greater fall in temperature based on the temperature difference between Fort Wayne and Washington at 0130 E. S. T. and the Washington 0130 E. S. T. temperature.

For a measure of the strength of flow expected during the forecast period, pressure differences were computed from the 0130 E. S. T. surface chart as indicated in figure 8. These indices are taken somewhat to the west of the station, to try to account for the general west to east movement of pressure systems, and they are oriented so as to obtain the maximum pressure differences when northwest or southwest flows are indicated. Pressure differences were computed for each of the 175 cases of original data that met the three criteria for a large drop in temperature. Using these pressure differences, or indices, as coordinates the temperature change was plotted, probabilities of a 10° drop computed, and isopleths drawn resulting in the pattern in figure 9.

For each of the 175 cases two probabilities of a 10° fall were obtained from figures 7 and 9. Using these two probabilities as coordinates the temperature change was again plotted at the point determined by each pair of probabilities. Probabilities of a 10° drop were again computed on this new chart and isopleths of probabilities drawn resulting in figure 10. Figure 10 gives the final estimate of the probability of a drop in temperature of 10° or more from 0130 E. S. T. to the minimum temperature the following night.

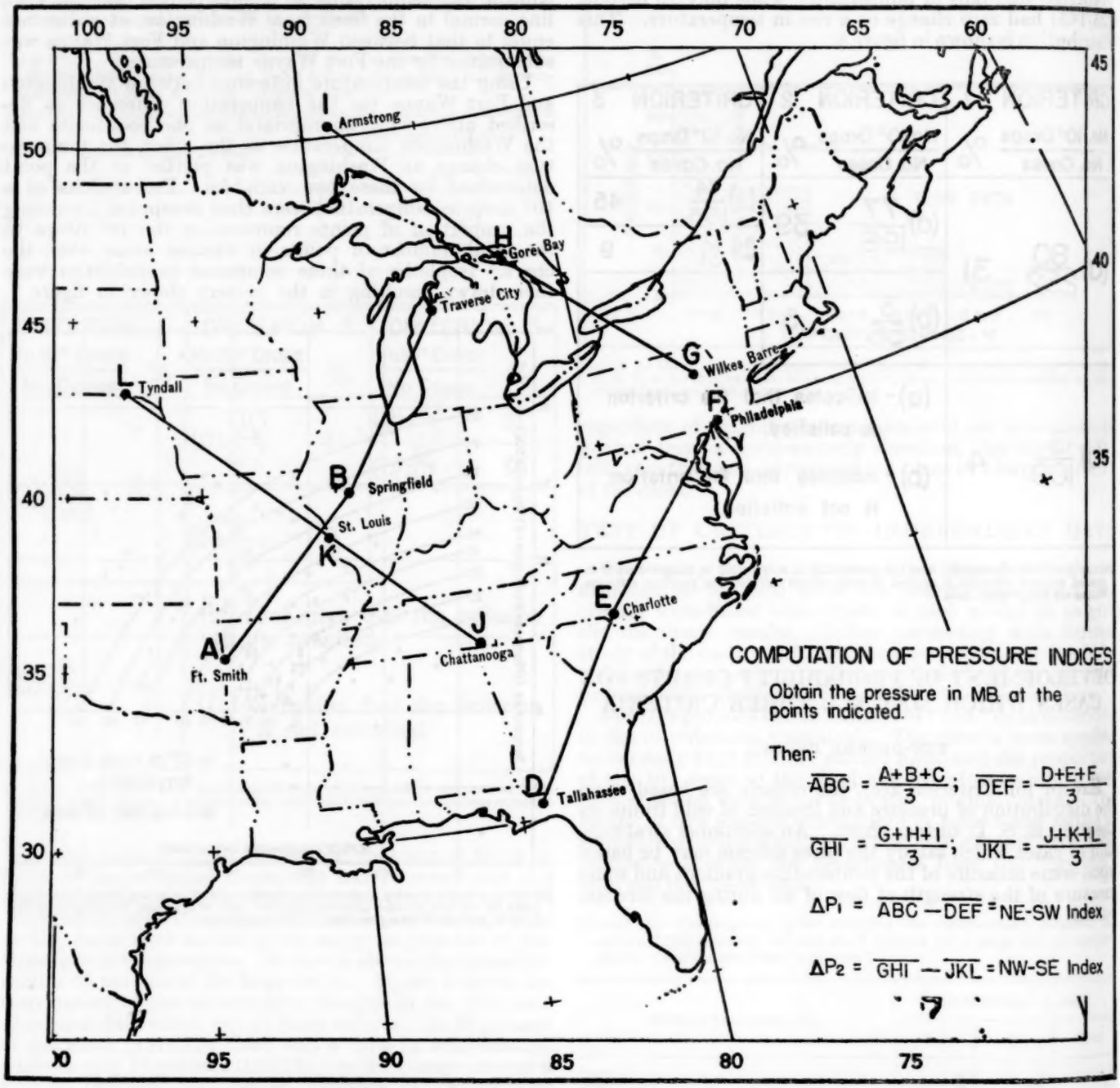

FIGURE 8.—Map showing location of points at which pressures are obtained for computing the pressure indices, ΔP_1, and ΔP_2.

The ability of figure 10 to forecast, or express, a correct probability of a 10° drop in temperature was tested on the 165 cases of "test" data which met the three criteria for a large fall in temperature. For each case the 0130 E. S. T. temperature at Washington and the temperature difference between Washington and Fort Wayne were obtained. If the case was one in which Fort Wayne was just east or south of a cold front, the temperature difference as described above was obtained instead of the temperature difference between Washington and Fort Wayne. Entering figure 7 with these two variables, a probability of a 10° drop was obtained. Pressure indices were computed for each case by the method illustrated in figure 8. Figure 9 was entered with these pressure differences and a second probability obtained. Entering figure 10 with the probabilities from figures 7 and 9, a final probability of a 10° drop was obtained for each of the 165 cases.

In table 4 these probabilities were grouped according to five class intervals, and the number of 10° drops which would be expected in each class was compared with the observed number of 10° drops in each class.[1] Thus, for example, 32 cases were found for which the probability obtained from figure 10 lay in the 40–59 percent group. The number of 10° drops which might be expected to fall in this group is 16 (50 percent of the 32 cases). The number of 10° drops observed in this group was 15.

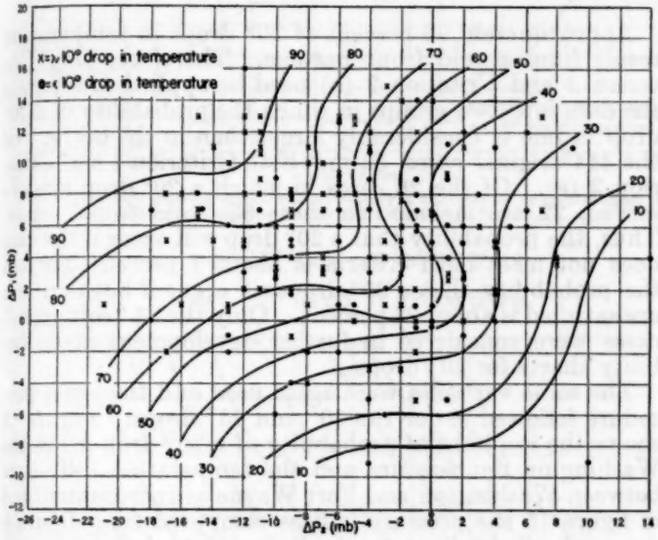

FIGURE 9.—Graph showing isopleths of probability of a 10° or greater drop based on pressure indicies computed by method shown in figure 8.

TABLE 4.—*Comparison of expected and observed number of 10° drops in class intervals of computed probability of 10° drops. Values are from "test data"*

Class intervals of objectively estimated probability of a 10° drop in temperature (percent)	Number of cases in each class	Approximate number of 10° drops expected in each class	Number of observed 10° drops in each class
0–19	25	2	1
20–39	52	16	9
40–59	32	16	15
60–79	19	13	18
80–99	37	33	31

FIFTEEN DEGREE DROPS

Exactly the same variables were used in constructing charts for 15° drops as were used for 10° drops. The temperature changes of the 175 cases of original data were again plotted using the Washington temperature and the temperature differences between Washington and Fort Wayne as coordinates for one chart (fig. 11) and the pressure indices computed from figure 8 as coordinates for

[1] A Chi square test was made of the consistency between the distribution of the expected number of 10° drops and the distribution of the observed number. These data do not reject the hypothesis that the frequencies in the independent data are from the same population as the frequencies on which the computed probabilities are based.

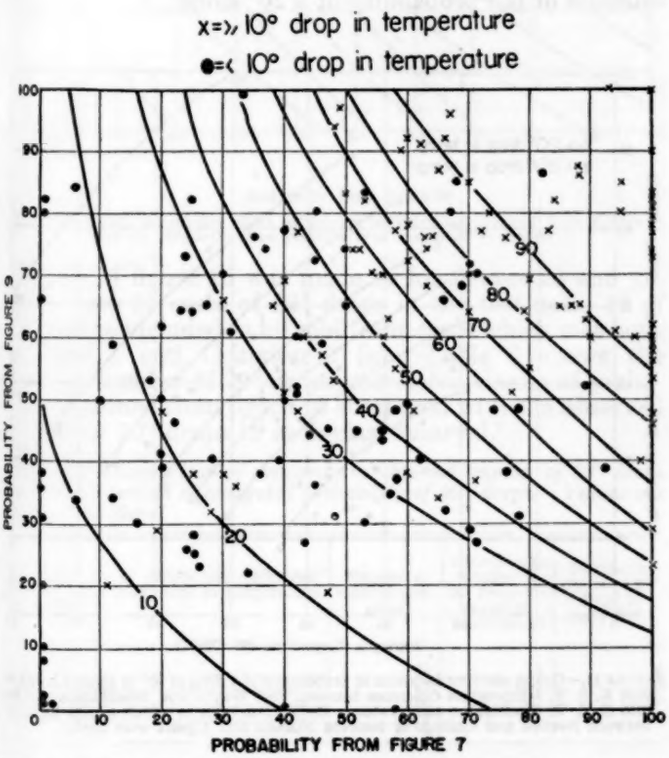

FIGURE 10.—Joint probability chart combining probabilities obtained from figures 7 and 9. Isopleths show probability of drop of 10° or greater.

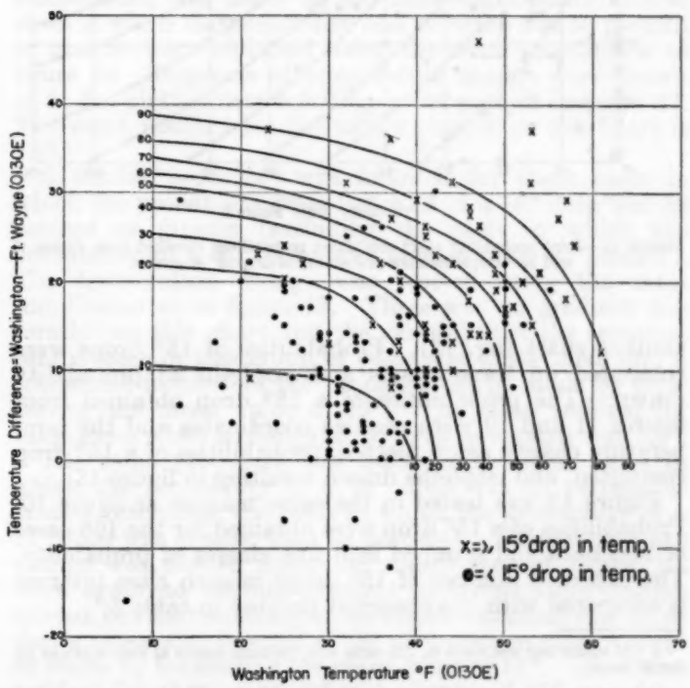

FIGURE 11.—Graph showing isopleths of probability of a 15° or greater drop in temperature based on the 0130 E. S. T. temperature difference between Fort Wayne and Washington and the Washington 0130 E. S. T. temperature.

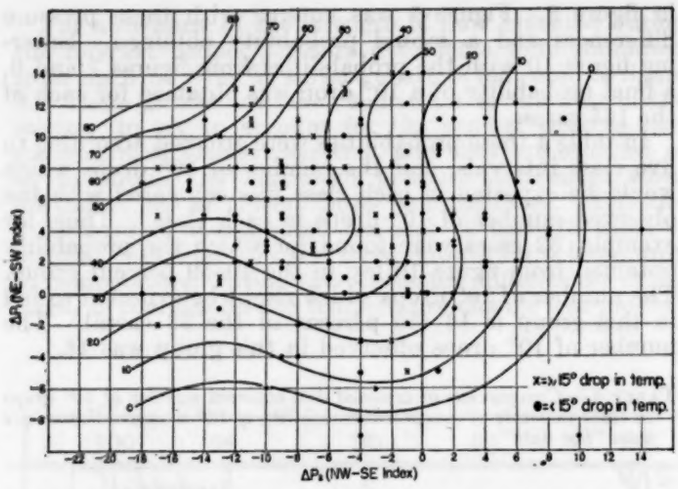

FIGURE 12.—Graph showing isopleths of probability of a 15° or greater drop based on pressure indices computed by method shown in figure 8.

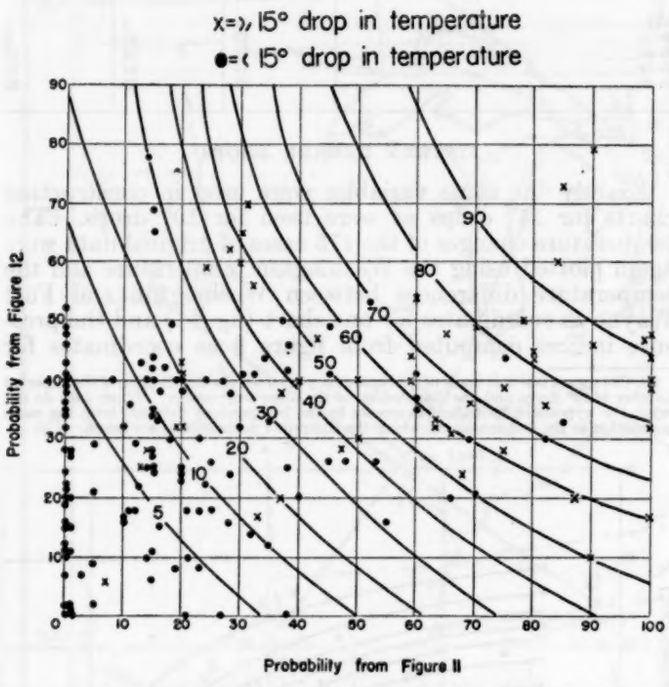

FIGURE 13.—Joint probability chart combining probabilities obtained from figures 11 and 12. Isopleths show probability of drop 15° or greater.

another chart (fig. 12). Probabilities of 15° drops were computed on these charts and isopleths of probability drawn. The probabilities of a 15° drop obtained from figures 11 and 12 were used as coordinates and the temperature change again plotted, probabilities of a 15° drop computed, and isopleths drawn resulting in figure 13.

Figure 13 was tested in the same manner as figure 10. Probabilities of a 15° drop were obtained for the 165 cases of test data and grouped into five classes of probability. The expected number of 15° drops in each class interval is compared with the observed number in table 5.[2]

[2] A Chi square test was made on this table with the same results as were obtained for the 10° drops.

TABLE 5.—*Comparison of expected and observed number of 15° drops in class intervals of computed probability of 15° drops. Values are from "test data"*

Class intervals of objectively estimated probability of a 15° drop in temperature (percent)	Number of cases in each class	Approximate number of 15° drops expected in each class	Number of observed 15° drops in each class
0–19	95	10	6
20–39	26	8	4
40–59	17	9	9
60–79	14	10	11
80–99	13	12	10

TWENTY-DEGREE DROPS

Approximately 90 percent of 20° drops in temperature result from a cold front passage. Therefore, only Criterion 1 and Criterion 2 (a) need be applied to separate the data into two groups in which the probability of a 20° drop in one is considerably larger than in the other. Of the 414 original cases, 83 met both Criterion 1 and Criterion 2 (a). Of the 26 cases in which a 20° drop was observed, 22 are included in these 83 "cold front" cases. Thus, the probability that a 20° drop will occur if the case does not meet both criteria is about 1 percent whereas the probability that a 20° drop will occur if both criteria are satisfied is about 27 percent. Only the 83 "cold front" cases were considered in further development of probability charts for 20° drops.

The same variables were again used and the same procedure followed as for the 10° and 15° drops. Figure 14 shows the isopleths of probability of a 20° drop using the Washington temperature and the temperature difference between Washington and Fort Wayne as coordinates, and in figure 15 the pressure indices computed from figure 8 are used as coordinates. In figure 16 probabilities estimated from the isopleths of figures 14 and 15 are used as coordinates and new isopleths drawn which give the final estimate of the probability of a 20° drop.

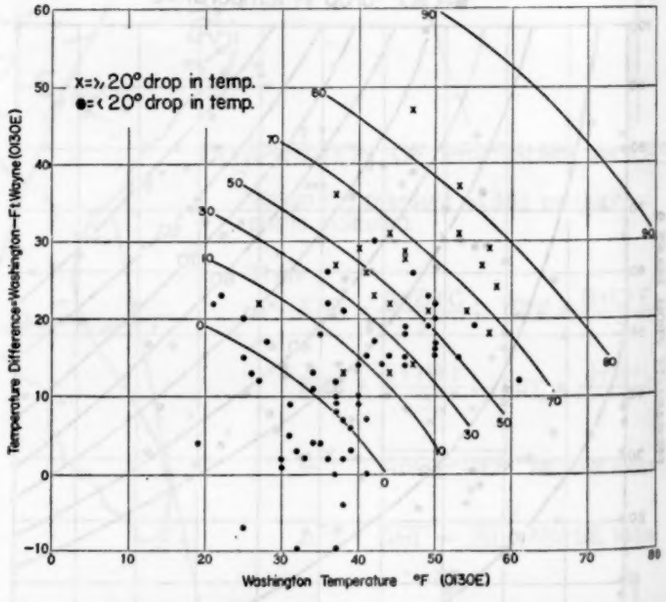

FIGURE 14.—Graph showing isopleths of probability of a drop of 20° or greater based on 0130 E. S. T. temperature difference between Fort Wayne and Washington and the 0130 E. S. T. Washington temperature. Only those cases in which a cold front lay between Norfolk and Chicago or between Norfolk and Alpena were used.

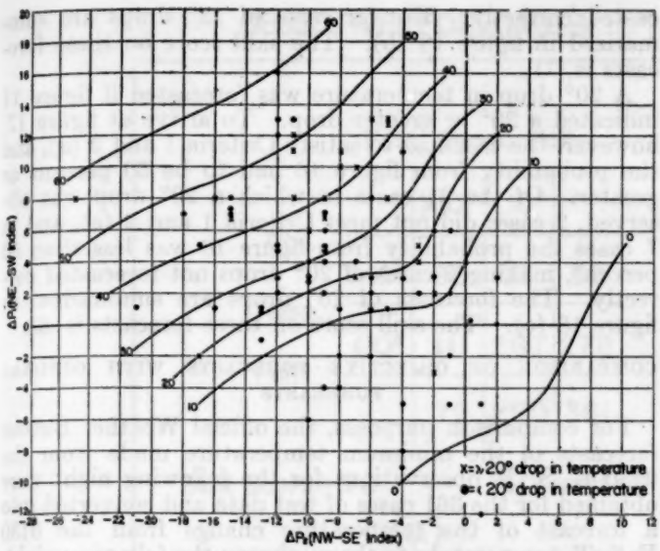

FIGURE 15.—Graph showing isopleths of probability of a drop of 20° or greater based on pressure indices computed by method shown in figure 8.

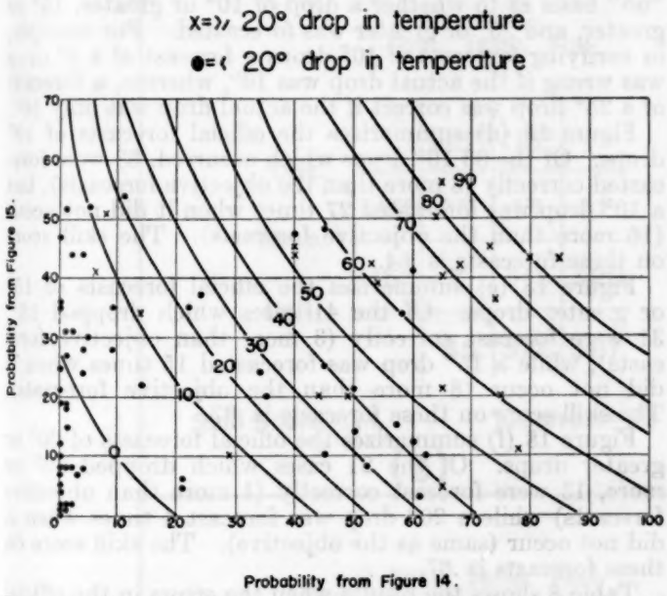

FIGURE 16.—Joint probability chart combining probabilities obtained from figures 14 and 15. Isopleths show probability of drop of 20° or greater.

A test of figure 16 was made as for figures 10 and 13. There were 21 cases of 20° drops in the test data, 19 of which were included in 90 cold front cases which met both Criterion 1 and Criterion 2 (a). Table 6 shows the expected number of 20° drops in selected classes of probability obtained from figure 16 compared with the observed number of 20° drops in each class interval.[3]

TABLE 6.—*Comparison of expected and observed number of 20° drops in class intervals of computed probability of 20° drops. Values are from "test data"*

Class intervals of objectively estimated probability of a 20° drop in temperature (percent)	Number of cases in each class	Approximate number of 20° drops expected in each class	Number of observed 20° drops in each class
<10	56	3	4
10–49	15	4 or 5	3
50–89	16	11	9
90–›90	3	3	3

[3] A Chi square test was also made on this table with same results as obtained for 10° drops.

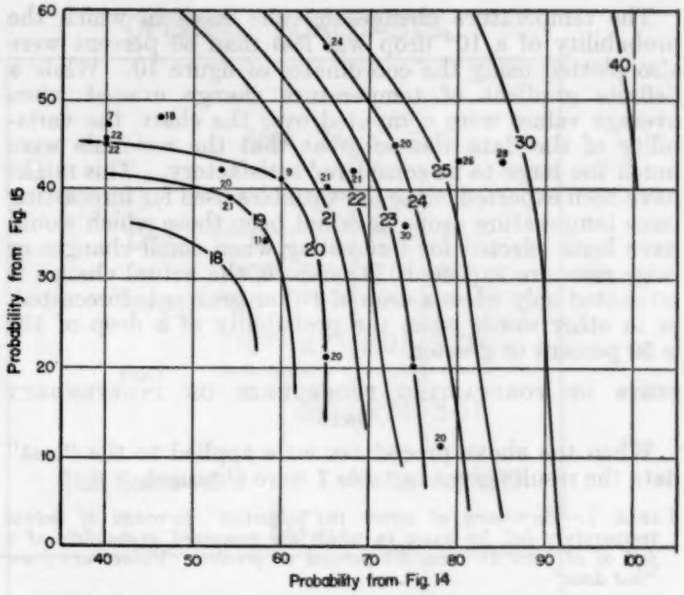

FIGURE 17.—Graph showing isograms of observed temperature change based on 50 percent or greater probabilities obtained from figures 14 and 15.

FORECASTS OF LARGE FALLS IN TEMPERATURE

DEVELOPMENT OF FORECASTING PROCEDURES

A probability statement does not give a "yes" or "no" answer as to whether an event will occur, but merely states what chance the event has of occurring under certain given conditions. In order to make a definite forecast as to whether or not the event will occur, some level of probability must be chosen as a dividing value. The 50 percent level is ordinarily adopted, and that value is used here. A 10° drop was forecasted if the probability of a 10° drop was 50 percent or greater, and similarly for 15° and 20° drops. An estimate of the actual change in temperature was made in the following manner: Those cases in which the probability of a 20° drop was 50 percent or greater were replotted using the same coordinates as figure 16. Isograms of temperature change were drawn to fit the plotted data resulting in the pattern in figure 17. The mean residual for the values plotted on this chart is 2.6°.

A similar procedure was followed for those cases in which the probability from figure 13 of a 15° drop was 50 percent or greater (excluding the cases in which the probability of a 20° drop was greater than 50 percent). The temperature change was plotted using the same coordinates as in figure 13. There was no gradient discernible on this chart, but the variability of the temperature change in this group of cases was quite small and a reasonable forecast of the change could be made by forecasting the mean value of 16°. The mean residual for these cases when a change of 16° was forecasted was 3.0°.

The same procedure was followed for those cases in which the probability of a 10° drop was 50 percent or greater (excluding the cases in which the probability of a 15° drop was greater than 50 percent). The temperature change was plotted using the coordinates of figure 10. Here again no definite gradient of temperature change existed, but the variability of the values was small enough so that a reasonable forecast of the temperature change could be made by forecasting the mean value of 13°. The mean residual for these cases when a change of 13° was forecasted was 4.3°.

The temperature changes for the cases in which the probability of a 10° drop was less than 50 percent were also plotted using the coordinates of figure 10. While a definite gradient of temperature change existed when average values were computed over the chart, the variability of the data was so great that the residuals were much too large to be considered satisfactory. This might have been expected, since the variables used for forecasting large temperature drops have not been those which would have been selected for forecasting when small changes or large rises are expected. Therefore, the actual change is estimated only when a drop of 10° or greater is forecasted, or in other words when the probability of a drop of 10° is 50 percent or greater.

TESTS OF FORECASTING PROCEDURES ON INDEPENDENT DATA

When the above procedures were applied to the "test" data the results given in table 7 were obtained.

TABLE 7.—*Summary of errors in "objective" forecasts of actual temperature fall for cases in which the computed probability of a fall of at least 10° was 50 percent or greater. Values are from "test data"*

Computed probability	Number of cases	Average error	Average change	Percent of error within 5°	Extreme error
		°F.	°F.	Percent	°F.
≥50 percent probability of a 20° drop	18	4.1	24	72	15
≥50 percent probability of 15° drop but <50 percent probability of 20° drop	17	3.5	15	88	−16
≥50 percent probability of 10° drop but <50 percent probability of 15° drop	36	3.9	13	75	17
Total	71	3.9	16	77	17

Since a drop in temperature of at least 10° is automatically forecasted when the probability from figure 10 is 50 percent or greater, and similarly for 15° and 20° drops, the skill with which these procedures forecast 10° or greater, 15° or greater, and 20° or greater drops can be evaluated. A 10° drop was forecasted if the case met all three criteria and the probability from figure 10 was 50 percent or greater. From table 3 it is seen that there were nine cases of test data in which the observed drop was 10° or greater, but which did not meet all three criteria. Of the 74 cases of 10° drops which met all three criteria, there were 13 in which the probability from figure 10 was less than 50 percent, making a total of 22 cases of 10° drops which were forecasted incorrectly. The forecasts of 10° drops are summarized in figure 18 (a). The skill score [4] on these forecasts is 0.72.

A 15° or greater drop was forecasted if the case satisfied all three criteria and the probability from figure 13 was 50 percent or greater. One case in which a 15° drop occurred did not meet all three criteria, and there were 12 cases in which the probability from figure 13 was less than 50 percent, making 13 cases of 15° drops not forecasted correctly. The forecasts of 15° drops are summarized in figure 18 (b). The skill score on these forecasts is .71.

A 20° drop in temperature was forecasted if figure 17 indicated a 20° or greater drop. To arrive at figure 17, however, the case had to satisfy Criteria 1 and 2 (a), and the probability from figure 16 had to be 50 percent or greater. Of the 21 cases in which a 20° drop was observed, 2 cases did not meet Criteria 1 and 2 (a), and in 7 cases the probability from figure 16 was less than 50 percent, making 9 cases of 20° drops not forecasted correctly. The forecasts of 20° drops are summarized in figure 18 (c). The skill score on these forecasts is .63.

COMPARISON OF OBJECTIVE FORECASTS WITH OFFICIAL FORECASTS

For comparison purposes, the official Weather Bureau forecasts of the minimum temperature made from the 0130 E. S. T. observations for the following night were obtained for the 361 cases of test data and converted into a forecast of the temperature change from the 0130 E. S. T. temperature to the minimum the following night. The forecasts were then verified strictly on a "yes" or "no" basis as to whether a drop of 10° or greater, 15° or greater, and 20° or greater was forecasted. For example, in verifying forecasts of 10° drops a forecast of a 9° drop was wrong if the actual drop was 10°, whereas, a forecast of a 25° drop was correct if the actual drop was only 10°.

Figure 18 (d) summarizes the official forecasts of 10° drops. Of the 83 10° drops which occurred, 63 were forecasted correctly (3 more than the objective forecasts), but a 10° drop was forecasted 27 times when it did not occur (16 more than the objective forecasts). The skill score on these forecasts is .64.

Figure 18 (e) summarizes the official forecasts of 15° or greater drops. Of the 41 cases which dropped 15°, 31 were forecast correctly (3 more than objective forecasts), while a 15° drop was forecasted 15 times when it did not occur (8 more than the objective forecasts). The skill score on these forecasts is .67.

Figure 18 (f) summarizes the official forecasts of 20° or greater drops. Of the 21 cases which dropped 20° or more, 13 were forecast correctly (1 more than objective forecasts) while a 20° drop was forecast 4 times when it did not occur (same as the objective). The skill score on these forecasts is .67.

Table 8 shows the results when the errors in the official forecasts of the actual minimum temperature are evaluated. Only the 71 cases in which an objective forecast was made are listed to compare with table 7.

TABLE 8.—*Summary of errors in "official" forecasts of actual temperature fall in cases in which the computed probability of a fall of at least 10° was 50 percent or greater. Forecasts were for same cases as are summarized in table 7*

Computed probability	Number of cases	Average error	Average change	Percent of errors within 5°	Extreme error
		°F.	°F.	Percent	°F.
≥50 percent probability of a 20° drop	18	3.7	24	78	8
≥50 percent probability of 15° drop but <50 percent probability of 20° drop	17	3.7	15	76	10
≥50 percent probability of 10° drop but <50 percent probability of 15° drop	36	4.2	13	61	13
Total	71	4.0	16	69	13

A comparison of tables 7 and 8 shows that the objective forecast has essentially the same average error as the official forecast and has a higher percentage of small errors, but tends to make larger errors than the official when it does fail.

[4] Skill Scores were computed from the formula:

$$\text{Skill Score}=\frac{C-E_e}{T-E_e}$$

where C=number of correct forecasts
T=total number of forecasts
E_e=expected number of correct forecasts based on the marginal totals of the contingency table.

For example in the table below:

$C=a+d$
$T=\text{Total forecasts}=(a+b+c+d)$
$E_e=\frac{(a+b)(a+c)+(c+d)(b+d)}{T}$

		Forecast of Event: Yes	No	
Observed Event	Yes	a	b	$a+b$
	No	c	d	$c+d$
		$a+c$	$b+d$	Total

OBJECTIVE FORECASTS

Fcst. Temp. Fall

Obs. Temp. Fall	≥10°	<10°	
≥10°	60	23	83
<10°	11	267	278
	71	290	361

Skill Score = .72 %Correct = 91

(a)

Fcst. Temp. Fall

Obs. Temp. Fall	≥15°	<15°	
≥15°	28	13	41
<15°	7	313	320
	35	326	361

Skill Score = .71 %Correct = 95

(b)

Fcst. Temp. Fall

Obs. Temp. Fall	≥20°	<20°	
≥20°	12	9	21
<20°	4	336	340
	16	345	361

Skill Score = .63 %Correct = 96

(c)

OFFICIAL FORECASTS

Fcst. Temp. Fall

Obs. Temp. Fall	≥10°	<10°	
≥10°	63	20	83
<10°	27	251	278
	90	271	361

Skill Score = .64 %Correct = 87

(d)

Fcst. Temp. Fall

Obs. Temp. Fall	≥15°	<15°	
≥15°	31	10	41
<15°	15	305	320
	46	315	361

Skill Score = .67 %Correct = 93

(e)

Fcst. Temp. Fall

Obs. Temp. Fall	≥20°	<20°	
≥20°	13	8	21
<20°	4	336	340
	17	344	361

Skill Score = .67 %Correct = 97

(f)

FIGURE 18.—Contingency tables showing comparison between "objective" and "official" forecasts of large falls in temperature at Washington, D. C.

SUMMARY

A large fall in temperature is defined as a drop of 10° or greater from the 0130 E. S. T. temperature to the minimum the following night. The following is a summary of the steps to be followed to arrive at a probability statement of a large drop in temperature and an estimate of the actual drop if the probability is greater than 50 percent.

1. Three criteria based on the pressure distribution and location of cold fronts on the 0130 E. S. T. surface chart must be met before a large drop is considered likely. If all three criteria are not satisfied, the probability of a drop of as much as 10° is approximately 4 percent.
2. If all three criteria are satisfied:
   a. The 0130 E. S. T. temperature at Washington and Fort Wayne are obtained. If the case is one in which Fort Wayne is just to the east or south of a cold front, the temperature at Fort Wayne is not used. Instead, if the front has an east-west orientation and lies between Fort Wayne and Alpena, the temperature at a point along a normal to the front from Washington at a distance equal to the distance between Washington and Fort Wayne is substituted for the Fort Wayne temperature. If the front has a north-south orientation and lies between Fort Wayne and Chicago the temperature at Madison is substituted for the Fort Wayne temperature.
   b. Pressure differences are computed as illustrated in figure 8.
   c. Figure 7 is entered with the Washington temperature and the temperature difference between Washington and Fort Wayne, and a probability estimated from the isopleths.
   d. Figure 9 is entered with the pressure differences computed from Figure 8, and a probability estimated from the isopleths.
   e. Figure 10 is entered with the probabilities obtained from figures 7 and 9, and the final probability of a 10° drop estimated from the isopleths.
   f. Using the same variables as above, figures 11, 12, and 13, are used to obtain the probability of a 15° drop.
   g. If the case is one in which a cold front exists between Norfolk and either Chicago or Alpena, then the same variables as above are used to enter figures 14, 15, and 16 to obtain the probability of a 20° drop. If the case is one in which no cold front exists, the probability of a 20° drop is only about 1 percent.
3. Estimating the actual drop.
   a. If the probability of a 20° drop is 50 percent or greater, enter figure 17 with the probabilities obtained from figures 14 and 15 and read off the estimate of the actual drop from the isograms.
   b. If the probability of a 15° drop is 50 percent or greater, but the probability of a 20° drop is less than 50 percent, forecast 16° as the temperature drop.
   c. If the probability of a 10° drop is 50 percent or greater, but the probability of a 15° drop is less than 50 percent, forecast 13° for the temperature drop.

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3. J. C. Thompson, "Second Progress Report on Objective Rainfall Forecasting Research Program for the Los Angeles Area," *Weather Bureau Research Report*, July 1947. (Unpublished.)
4. Edward M. Vernon, "An Objective Method of Forecasting Precipitation 24–48 Hours in Advance at San Francisco, California," *Monthly Weather Review*, vol. 75, No. 11, November 1947, pp. 211–219.
5. S. Penn, "An Objective Method for Forecasting Precipitation Amounts from Winter Coastal Storms for Boston," *Monthly Weather Review*, vol. 76, No. 8, August 1948, pp. 149–161.
6. Wayne C. Palmer, "On Forecasting the Direction of Movement of Winter Cyclones," *Monthly Weather Review*, vol. 76, No. 9, September 1948, pp. 181–201.

METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR MARCH 1949

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see REVIEW, January 1946, p. 6]

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during March 1949*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,004.3 mb.)				Albuquerque, N. Mex. (834.3 mb.)				Atlanta, Ga. (983.4 mb.)				Big Spring, Tex. (924.8 mb.)				Bismarck, N. Dak. (956.7 mb.)				Boise, Idaho (912.9 mb.)				Brownsville, Tex. (1,013.3 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	86	1.2	69	31	1,620	9.7	35	31	300	11.0	62	31	774	13.0	51	31	505	−4.2	82	31	868	7.2	59	31	6	19.8	86
1,000	31	120	(*)	----	31	83	(*)	----	31	160	(*)	----	31	107	(*)	----	31	151	(*)	----	31	108	(*)	----	31	119	19.7	85
950	31	537	.5	59	31	529	(*)	----	31	590	10.9	55	31	550	(*)	----	31	560	(*)	----	31	540	(*)	----	31	565	18.1	80
900	31	964	−1.7	60	31	989	(*)	----	31	1,038	8.4	53	31	1,003	14.2	46	31	984	−5.4	74	31	985	7.8	48	31	1,023	16.9	64
850	31	1,417	−3.6	60	31	1,465	(*)	----	31	1,509	6.9	47	31	1,483	12.6	38	31	1,433	−5.9	65	31	1,454	4.7	48	31	1,509	15.6	53
800	31	1,894	−5.6	56	31	1,968	8.8	33	31	2,006	5.5	43	31	1,990	10.4	33	31	1,907	−6.8	56	31	1,944	.8	54	31	2,022	13.9	44
750	31	2,405	−7.8	58	31	2,506	4.6	37	31	2,537	3.4	39	31	2,529	7.5	29	31	2,415	−8.7	51	31	2,460	−3.3	61	31	2,566	11.8	38
700	31	2,933	−10.2	61	31	3,055	.1	41	31	3,089	.6	40	31	3,088	3.4	30	31	2,942	−11.0	50	31	3,001	−7.5	66	31	3,138	8.7	30
650	31	3,507	−12.6	60	31	3,647	−4.7	43	31	3,682	−2.8	39	31	3,688	−.6	29	31	3,518	−14.1	50	31	3,575	−11.4	65	31	3,745	4.2	31
600	31	4,109	−15.6	60	31	4,267	−9.6	44	31	4,310	−6.8	35	31	4,319	−5.1	27	31	4,111	−17.5	50	31	4,183	−15.1	60	31	4,391	−.6	30
550	31	4,764	−19.3	57	31	4,936	−14.2	39	31	4,984	−11.5	32	31	4,998	−10.2	28	31	4,762	−21.1	----	31	4,837	−19.7	56	30	5,079	−5.6	30
500	31	5,463	−23.9	----	31	5,649	−19.4	35	31	5,708	−16.4	34	31	5,724	−15.7	30	30	5,459	−25.5	----	31	5,536	−24.9	----	30	5,820	−10.8	31
450	31	6,229	−29.0	----	31	6,430	−25.4	----	31	6,497	−22.0	----	31	6,514	−21.1	----	30	6,220	−31.1	----	31	6,298	−30.2	----	30	6,632	−16.4	30
400	31	7,056	−34.8	----	31	7,267	−31.3	----	31	7,348	−28.1	----	30	7,369	−27.4	----	30	7,040	−37.2	----	31	7,121	−36.3	----	30	7,497	−23.0	----
350	31	7,974	−41.5	----	31	8,201	−37.5	----	31	8,293	−34.9	----	30	8,316	−34.2	----	29	7,949	−44.1	----	31	8,033	−43.5	----	29	8,460	−30.3	----
300	30	9,007	−48.0	----	31	9,249	−44.3	----	31	9,350	−43.0	----	30	9,377	−42.1	----	27	8,965	−50.9	----	31	9,051	−51.6	----	29	9,539	−38.1	----
250	30	10,194	−52.9	----	30	10,455	−50.8	----	29	10,550	−51.9	----	29	10,595	−50.4	----	23	10,137	−55.8	----	30	10,220	−55.5	----	28	10,768	−47.5	----
200	30	11,625	−54.8	----	29	11,891	−56.0	----	28	11,979	−58.1	----	27	12,035	−56.8	----	20	11,559	−55.7	----	26	11,640	−52.7	----	25	12,207	−55.9	----
175	27	12,476	−53.3	----	28	12,740	−56.5	----	25	12,831	−58.9	----	25	12,884	−58.2	----	13	12,421	−53.8	----	25	12,503	−51.5	----	19	13,058	−60.4	----
150	25	13,468	−54.2	----	27	13,715	−56.7	----	18	13,817	−60.6	----	24	13,852	−59.5	----	6	13,408	−52.9	----	25	13,502	−52.1	----	18	14,011	−63.8	----
125	21	14,641	−55.5	----	21	14,867	−57.5	----	10	14,979	−64.0	----	23	14,989	−61.3	----	----	----	----	----	17	14,677	−53.4	----	11	15,132	−66.3	----
100	13	16,072	−57.1	----	10	16,256	−58.9	----	6	16,338	−66.0	----	11	16,332	−63.3	----	----	----	----	----	9	16,100	−54.0	----	7	16,465	−71.5	----
80	5	17,449	−57.6	----	5	17,643	−60.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

	Buffalo, N. Y. (988.8 mb.)				Camaguey, Cuba [1] (---- mb.)				Caribou, Maine (988.2 mb.)				Charleston, S. C. (1,016.8 mb.)				Ciudad Victoria, Mex. (972.0 mb.)				Columbia, Mo. (987.9 mb.)				Dodge City, Kans. (923.3 mb.)			
Surface	31	221	0.5	74	----	----	----	----	31	191	−5.7	75	31	13	11.3	78	28	335	25.0	51	31	239	5.3	70	31	792	3.8	78
1,000	31	130	(*)	----	----	----	----	----	31	96	(*)	----	31	153	13.3	70	28	83	(*)	----	31	136	(*)	----	31	134	(*)	----
950	31	545	−.3	69	----	----	----	----	31	502	−5.4	65	31	588	12.0	63	28	537	23.4	54	31	563	5.1	63	31	559	(*)	----
900	31	972	−2.5	67	----	----	----	----	31	923	−7.1	62	31	1,036	9.7	59	28	1,005	20.0	59	31	996	3.0	60	31	999	4.4	71
850	31	1,424	−4.0	63	----	----	----	----	31	1,367	−8.2	62	31	1,509	7.6	57	28	1,496	16.8	64	31	1,458	1.8	54	30	1,461	4.7	62
800	31	1,901	−5.9	62	----	----	----	----	31	1,837	−9.3	59	31	2,007	5.5	52	28	2,010	13.6	66	31	1,946	−.1	54	30	1,954	3.4	54
750	31	2,409	−8.1	56	----	----	----	----	31	2,337	−11.0	59	31	2,538	4.0	44	28	2,559	11.4	54	31	2,470	−1.6	52	30	2,479	1.5	47
700	31	2,938	−10.4	53	----	----	----	----	31	2,862	−13.4	60	30	3,091	1.4	37	28	3,127	9.0	45	31	3,008	−3.7	48	30	3,029	−1.6	40
650	31	3,512	−12.9	53	----	----	----	----	30	3,425	−16.1	55	30	3,688	−2.1	----	27	3,738	5.1	38	31	3,600	−6.8	43	29	3,618	−5.5	38
600	31	4,113	−15.9	50	----	----	----	----	30	4,021	−18.8	54	29	4,318	−6.1	----	27	4,386	.1	36	31	4,211	−10.6	40	29	4,238	−9.8	38
550	31	4,768	−19.5	49	----	----	----	----	30	4,667	−22.5	----	29	4,995	−10.6	----	27	5,076	−5.0	35	31	4,879	−15.0	37	29	4,901	−14.6	37
500	30	5,464	−24.2	----	----	----	----	----	30	5,358	−26.5	----	29	5,720	−15.8	----	25	5,821	−9.4	----	31	5,588	−19.9	37	29	5,618	−19.9	37
450	28	6,226	−29.6	----	----	----	----	----	30	6,117	−31.5	----	28	6,516	−21.5	----	25	6,638	−15.0	----	29	6,363	−26.0	----	29	6,396	−25.6	----
400	26	7,049	−35.5	----	----	----	----	----	30	6,937	−36.7	----	28	7,369	−27.8	----	25	7,511	−21.2	----	28	7,203	−32.6	----	29	7,233	−32.3	----
350	25	7,969	−41.7	----	----	----	----	----	30	7,850	−43.1	----	28	8,315	−34.8	----	25	8,481	−29.0	----	27	8,126	−39.6	----	29	8,161	−39.5	----
300	22	8,994	−48.0	----	----	----	----	----	29	8,865	−49.3	----	28	9,373	−42.9	----	25	9,564	−37.4	----	25	9,161	−47.0	----	27	9,193	−47.2	----
250	20	10,164	−53.8	----	----	----	----	----	28	10,040	−53.5	----	27	10,583	−51.2	----	25	10,797	−47.2	----	20	10,361	−53.4	----	26	10,376	−53.5	----
200	15	11,619	−55.8	----	----	----	----	----	27	11,482	−54.6	----	24	12,017	−57.0	----	24	12,240	−56.9	----	11	11,781	−54.6	----	20	11,813	−56.6	----
175	13	12,478	−54.8	----	----	----	----	----	22	12,299	−53.0	----	21	12,867	−57.4	----	21	13,074	−60.6	----	10	12,623	−54.8	----	19	12,667	−55.6	----
150	12	13,446	−54.1	----	----	----	----	----	12	13,351	−52.3	----	18	13,849	−58.7	----	8	14,019	−63.7	----	5	13,652	−54.7	----	15	13,638	−56.4	----
125	10	14,616	−55.1	----	----	----	----	----	8	14,491	−53.8	----	10	15,044	−63.5	----	----	----	----	----	----	----	----	----	12	14,799	−59.1	----
100	5	16,002	−53.5	----	----	----	----	----	----	----	----	----	8	16,416	−65.6	----	----	----	----	----	----	----	----	----	8	16,202	−59.6	----

	El Paso, Tex. (879.0 mb.)				Ely, Nev. (805.0 mb.)				Glasgow, Mont. (939.3 mb.)				Grand Junction, Colo. (849.0 mb.)				Great Falls, Mont (885.0 mb.)				Greensboro, N. C. (985.9 mb.)				Hatteras, N. C. (1,017.8 mb.)			
Surface	31	1,195	15.3	25	31	1,908	0.2	75	31	648	−2.6	73	31	1,474	5.4	67	31	1,128	−0.8	63	31	273	7.7	67	31	3	10.6	75
1,000	31	83	(*)	----	31	129	(*)	----	31	144	(*)	----	31	110	(*)	----	31	136	(*)	----	31	155	(*)	----	31	150	11.2	68
950	31	534	(*)	----	31	557	(*)	----	31	561	(*)	----	31	546	(*)	----	31	559	(*)	----	31	577	8.7	52	31	584	9.0	60
900	31	999	(*)	----	31	1,000	(*)	----	31	987	−1.8	64	31	995	(*)	----	31	997	(*)	----	31	1,026	5.8	55	31	1,023	6.5	57
850	31	1,479	14.8	24	31	1,466	(*)	----	31	1,441	−3.4	59	31	1,463	(*)	----	31	1,449	−1.4	53	31	1,492	3.0	55	31	1,490	4.2	53
800	31	1,988	10.8	26	31	1,959	1.6	64	31	1,918	−5.5	58	31	1,961	4.8	53	31	1,930	−3.7	52	31	1,981	.8	54	31	1,982	2.2	48
750	31	2,525	6.7	27	31	2,480	−1.4	58	31	2,424	−8.1	57	31	2,485	1.0	55	31	2,441	−6.9	55	31	2,504	−.8	46	31	2,504	2.1	40
700	31	3,083	2.8	28	31	3,022	−5.5	62	31	2,955	−10.6	53	31	3,035	−3.1	58	31	2,972	−9.7	58	31	3,047	−2.6	41	31	3,052	−2.3	39
650	31	3,680	−2.0	30	31	3,603	−9.3	59	31	3,528	−13.8	49	31	3,618	−7.5	59	31	3,548	−13.0	55	31	3,635	−5.4	39	31	3,641	−5.2	37
600	31	4,308	−6.7	28	31	4,214	−13.2	55	31	4,125	−17.4	47	31	4,235	−11.8	57	31	4,147	−16.6	48	30	4,260	−9.1	37	31	4,261	−9.0	35
550	31	4,985	−11.7	----	31	4,873	−17.5	54	31	4,774	−21.4	----	31	4,897	−16.7	58	31	4,796	−21.2	----	30	4,929	−13.1	35	31	4,930	−13.0	36
500	30	5,701	−17.0	----	31	5,579	−22.6	----	31	5,468	−26.2	----	31	5,604	−21.7	----	31	5,490	−26.5	----	30	5,648	−18.1	37	31	5,649	−17.7	37
450	30	6,490	−22.3	----	31	6,346	−28.4	----	31	6,227	−31.7	----	31	6,376	−27.4	----	31	6,248	−32.0	----	29	6,431	−23.8	----	31	6,435	−23.2	----
400	30	7,339	−28.6	----	31	7,177	−34.9	----	29	7,049	−37.8	----	31	7,208	−33.8	----	31	7,063	−38.2	----	27	7,275	−30.1	----	29	7,285	−29.6	----
350	29	8,284	−35.0	----	31	8,095	−42.0	----	29	7,956	−44.3	----	31	8,129	−40.7	----	31	7,968	−44.9	----	26	8,221	−36.9	----	28	8,226	−36.2	----
300	29	9,342	−42.8	----	29	9,114	−48.9	----	24	8,999	−51.4	----	31	9,162	−47.6	----	31	8,982	−51.7	----	23	9,279	−44.6	----	28	9,279	−43.7	----
250	29	10,551	−50.9	----	29	10,294	−54.5	----	23	10,163	−57.0	----	30	10,354	−53.1	----	31	10,150	−56.2	----	23	10,459	−52.8	----	26	10,474	−52.1	----
200	24	11,979	−56.6	----	28	11,715	−54.1	----	18	11,581	−56.1	----	25	11,773	−55.0	----	30	11,566	−54.4	----	20	11,877	−56.9	----	18	11,920	−57.9	----
175	19	12,831	−57.6	----	27	12,567	−53.0	----	16	12,432	−54.7	----	22	12,623	−52.6	----	30	12,424	−53.0	----	14	12,745	−57.4	----	18	12,762	−57.4	----
150	15	13,782	−58.1	----	26	13,557	−53.4	----	14	13,425	−53.9	----	18	13,613	−51.7	----	29	13,420	−52.6	----	8	13,714	−58.9	----	9	13,803	−58.6	----
125	7	14,892	−59.4	----	20	14,728	−54.8	----	13	14,509	−54.1	----	12	14,783	−53.9	----	28	14,593	−53.8	----	5	14,849	−59.4	----	6	15,027	−62.2	----
100	----	----	----	----	7	16,150	−56.9	----	8	16,046	−55.4	----	----	----	----	----	18	16,030	−54.0	----	----	----	----	----	----	----	----	----
80	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7	17,491	−53.2	----	----	----	----	----	----	----	----	----

See footnotes at end of table

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during March 1949*—Continued

Standard pressure surface (mb.)	Havana, Cuba [1] (---- mb.)				Honolulu, T. H. (1,016.0 mb.)				International Falls, Minn. (973.4 mb.)				Joliet, Ill. (995.5 mb.)				Lake Charles, La. (1,016.5 mb.)				Lander, Wyo. (824.6 mb.)				Las Vegas, Nev. (935.2 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	----	----	----	----	31	3	24.1	59	31	360	−8.1	70	31	178	2.1	76	31	5	14.8	83	31	1,696	1.3	60	31	660	12.6	38
1,000	----	----	----	----	31	141	21.8	62	31	148	(*)	----	31	140	(*)	----	31	143	14.9	75	31	113	(*)	----	31	90	(*)	----
950	----	----	----	----	31	589	18.0	68	31	550	−7.0	66	31	556	1.3	65	31	581	13.4	67	31	544	(*)	----	31	527	(*)	----
900	----	----	----	----	31	1,045	14.4	73	31	968	−9.1	66	31	988	−.7	62	31	1,032	12.3	61	31	987	(*)	----	31	983	12.8	31
850	----	----	----	----	31	1,526	11.4	71	31	1,409	−9.8	65	31	1,443	−2.2	52	31	1,511	11.1	47	31	1,450	(*)	----	31	1,459	8.9	33
800	----	----	----	----	31	2,031	9.9	50	31	1,876	−11.1	59	31	1,924	−3.8	43	31	2,015	9.3	41	31	1,940	1.8	52	31	1,957	4.8	40
750	----	----	----	----	31	2,573	8.1	31	31	2,378	−12.4	54	31	2,436	−5.2	43	31	2,558	7.0	42	31	2,465	−1.1	49	31	2,482	.6	42
700	----	----	----	----	31	3,132	5.4	----	31	2,895	−14.4	53	31	2,972	−7.4	42	30	3,113	4.4	32	31	3,005	−5.0	49	31	3,028	−3.3	39
650	----	----	----	----	31	3,732	2.1	----	31	3,465	−16.7	51	31	3,550	−10.5	44	29	3,715	.5	34	31	3,588	−9.4	51	31	3,616	−7.2	36
600	----	----	----	----	31	4,375	−1.8	----	31	4,052	−19.9	45	31	4,158	−14.3	45	29	4,349	−3.7	----	31	4,197	−13.3	50	31	4,230	−11.2	31
550	----	----	----	----	31	5,060	−6.2	----	31	4,694	−23.6	----	31	4,815	−18.4	42	29	5,032	−8.5	----	31	4,856	−17.8	47	31	4,895	−15.6	33
500	----	----	----	----	31	5,800	−11.4	----	31	5,382	−27.9	----	31	5,517	−23.0	----	29	5,763	−13.8	----	31	5,559	−23.2	----	31	5,603	−21.0	----
450	----	----	----	----	31	6,604	−17.1	----	31	6,138	−32.5	----	31	6,284	−28.2	----	28	6,562	−19.4	----	31	6,330	−29.2	----	31	6,380	−26.9	----
400	----	----	----	----	31	7,473	−23.6	----	30	6,950	−38.2	----	31	7,115	−34.7	----	28	7,419	−25.9	----	31	7,152	−35.8	----	31	7,212	−33.1	----
350	----	----	----	----	31	8,435	−30.8	----	29	7,851	−44.6	----	31	8,035	−41.2	----	28	8,372	−33.0	----	31	8,064	−43.4	----	31	8,136	−40.1	----
300	----	----	----	----	31	9,512	−38.0	----	28	8,862	−51.0	----	30	9,068	−48.1	----	27	9,439	−40.9	----	31	9,083	−51.3	----	31	9,172	−47.1	----
250	----	----	----	----	31	10,751	−43.9	----	26	10,030	−54.2	----	30	10,251	−54.5	----	26	10,655	−50.4	----	30	10,251	−56.7	----	31	10,359	−53.8	----
200	----	----	----	----	30	12,226	−51.8	----	20	11,470	−52.1	----	29	11,673	−55.6	----	25	12,086	−58.6	----	24	11,674	−56.0	----	31	11,778	−56.5	----
175	----	----	----	----	30	13,082	−56.7	----	14	12,350	−51.2	----	27	12,517	−54.3	----	23	12,924	−61.6	----	19	12,517	−53.7	----	30	12,626	−54.4	----
150	----	----	----	----	30	14,047	−61.8	----	11	13,346	−51.0	----	26	13,500	−54.5	----	23	13,877	−62.9	----	16	13,506	−53.2	----	30	13,610	−55.6	----
125	----	----	----	----	29	15,163	−67.2	----	9	14,518	−51.9	----	22	14,688	−56.3	----	17	14,991	−67.2	----	11	14,677	−54.0	----	28	14,763	−58.0	----
100	----	----	----	----	28	16,490	−71.9	----					13	16,099	−57.9	----	13	16,332	−70.2	----	6	16,116	−56.1	----	23	16,158	−59.5	----
80	----	----	----	----	25	17,797	−71.9	----					6	17,514	−57.4	----									13	17,547	−59.0	----
60	----	----	----	----	20	19,513	−65.1	----																				
50	----	----	----	----	19	20,635	−60.9	----																				
40	----	----	----	----	18	22,035	−56.1	----																				
30	----	----	----	----	17	23,883	−51.6	----																				

Standard pressure surface (mb.)	Little Rock, Ark. (1,007.4 mb.)				Mazatlan, Mex. (1,009.1 mb.)				Medford, Oreg. (966.3 mb.)				Merida, Mex. (1,010.6 mb.)				Miami, Fla. (1,017.8 mb.)				Nantucket, Mass. (1,012.9 mb.)				Nashville, Tenn. (996.7 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	79	10.6	72	31	14	22.3	74	31	401	8.9	66	31	27	26.5	63	31	4	20.4	75	29	14	2.4	81	31	177	9.4	66
1,000	31	140	(*)	----	31	94	21.8	69	31	115	(*)	----	31	120	25.8	64	31	157	20.5	72	29	117	4.0	74	31	149	(*)	----
950	31	570	10.3	60	31	550	23.0	36	31	543	8.6	58	31	573	23.3	63	31	601	17.7	72	29	536	3.2	68	31	574	8.0	58
900	31	1,016	8.3	59	31	1,009	21.9	29	31	986	5.4	61	31	1,042	20.6	62	31	1,059	15.0	62	29	971	1.3	64	31	1,018	5.5	58
850	31	1,487	7.2	52	31	1,502	19.2	22	31	1,450	1.9	66	31	1,533	17.2	63	31	1,541	12.5	55	29	1,430	−.7	62	31	1,484	3.7	53
800	31	1,985	5.7	49	31	2,019	15.8	22	31	1,936	−1.9	73	31	2,048	13.5	67	31	2,048	10.4	42	29	1,912	−2.8	60	31	1,976	2.4	47
750	31	2,515	3.2	52	31	2,573	12.1	23	31	2,450	−5.3	72	31	2,594	11.2	51	31	2,590	8.3	33	29	2,427	−4.9	54	31	2,499	.0	46
700	31	3,067	.2	46	31	3,136	8.1	24	31	2,984	−8.7	69	31	3,163	8.4	33	31	3,149	5.5	----	29	2,961	−7.2	52	31	3,046	−2.1	40
650	31	3,660	−3.2	41	31	3,748	3.9	23	31	3,557	−12.2	63	31	3,775	5.5	----	31	3,752	2.2	----	29	3,538	−10.3	50	31	3,636	−5.4	42
600	31	4,287	−7.1	34	31	4,388	−.5	----	31	4,162	−16.2	56	30	4,421	2.0	----	31	4,392	−1.6	----	29	4,148	−13.8	51	31	4,255	−9.4	43
550	31	4,962	−11.7	34	30	5,078	−5.4	----	31	4,811	−20.4	53	29	5,118	−2.1	----	31	5,079	−5.7	----	29	4,807	−17.8	49	31	4,921	−14.0	43
500	31	5,683	−16.7	34	29	5,822	−9.9	----	31	5,510	−25.1	----	29	5,868	−7.2	----	31	5,819	−10.2	----	29	5,511	−22.3	----	31	5,639	−18.8	43
450	31	6,474	−22.3	----	29	6,634	−15.3	----	31	6,271	−30.5	----	29	6,686	−13.1	----	31	6,629	−15.9	----	29	6,282	−27.6	----	31	6,420	−24.2	----
400	31	7,322	−28.5	----	29	7,508	−21.4	----	31	7,094	−36.9	----	29	7,566	−20.0	----	31	7,501	−22.2	----	29	7,115	−33.5	----	31	7,264	−30.3	----
350	31	8,264	−35.4	----	28	8,476	−29.0	----	31	8,004	−43.4	----	28	8,540	−28.0	----	31	8,468	−29.7	----	29	8,039	−39.9	----	31	8,199	−37.5	----
300	30	9,316	−43.2	----	28	9,559	−37.4	----	30	9,031	−49.5	----	28	9,625	−37.0	----	31	9,547	−38.2	----	28	9,084	−46.6	----	31	9,246	−44.9	----
250	29	10,519	−51.5	----	28	10,794	−46.8	----	28	10,214	−53.8	----	28	10,857	−47.2	----	30	10,776	−47.7	----	26	10,279	−53.2	----	31	10,442	−52.6	----
200	27	11,947	−57.0	----	27	12,246	−56.2	----	26	11,635	−53.1	----	28	12,299	−57.3	----	26	12,214	−56.4	----	20	11,663	−54.3	----	26	11,886	−57.5	----
175	27	12,792	−56.9	----	25	13,088	−60.6	----	24	12,497	−51.1	----	27	13,130	−61.9	----	26	13,054	−59.6	----	18	12,487	−52.9	----	23	12,719	−56.6	----
150	22	13,769	−58.2	----	25	14,040	−63.9	----	21	13,498	−51.0	----	25	14,068	−67.0	----	20	14,018	−62.4	----	15	13,467	−52.9	----	20	13,705	−58.3	----
125	12	14,928	−60.6	----	24	15,147	−68.0	----	20	14,683	−52.3	----	20	15,156	−72.1	----	15	15,133	−67.3	----	12	14,618	−53.8	----	15	14,843	−59.7	----
100	9	16,320	−62.5	----	19	16,478	−72.0	----	19	16,115	−54.1	----	13	16,449	−76.2	----	8	16,464	−72.8	----	7	16,065	−56.6	----	7	16,245	−61.7	----
80	5	17,702	−63.1	----	8	17,798	−74.0	----	15	17,542	−54.8	----	5	17,716	−77.2	----												
60	----	----	----	----	----	----	----	----	5	19,375	−54.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	New Orleans, La. (1,017.5 mb.)				North Platte, Nebr. (916.5 mb.)				Oakland, Calif. (1,015.4 mb.)				Oklahoma City, Okla. (969.4 mb.)				Omaha, Nebr. (979.9 mb.)				Phoenix, Ariz. (972.4 mb.)				Pittsburgh, Pa. (971.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	2	15.4	80	31	849	1.7	76	31	6	11.6	75	31	391	9.2	69	31	308	2.9	74	31	339	16.3	33	31	382	3.7	70
1,000	31	149	16.1	72	31	136	(*)	----	31	134	10.6	75	31	129	(*)	----	31	140	(*)	----	31	98	(*)	----	31	140	(*)	----
950	31	589	13.6	68	31	560	(*)	----	31	562	7.9	70	31	561	9.5	64	31	558	1.2	69	31	541	18.2	25	31	564	3.3	65
900	31	1,038	11.9	62	31	995	2.5	70	31	1,003	5.1	70	31	1,005	7.7	65	31	991	−.1	67	31	998	14.6	26	31	995	.8	65
850	31	1,516	10.9	53	31	1,456	.7	62	31	1,467	2.3	67	31	1,475	6.3	58	31	1,448	−1.0	61	31	1,477	10.6	29	31	1,452	−1.6	63
800	30	2,022	9.6	42	31	1,941	−.9	60	31	1,955	−.4	62	31	1,972	5.5	47	31	1,931	−1.6	55	31	1,978	6.6	32	31	1,933	−3.8	57
750	30	2,559	6.9	35	31	2,459	−2.8	55	31	2,474	−3.3	55	31	2,499	2.7	41	31	2,448	−3.6	54	31	2,510	2.7	33	31	2,446	−5.9	53
700	30	3,118	3.9	34	31	2,998	−5.4	56	31	3,012	−6.3	51	31	3,051	−.1	36	31	2,986	−6.1	50	31	3,058	−1.3	31	31	2,979	−7.9	52
650	30	3,721	.3	35	31	3,581	−8.7	55	31	3,592	−9.8	49	31	3,642	−3.7	31	31	3,569	−9.3	45	31	3,645	−5.3	30	31	3,560	−10.8	51
600	30	4,353	−3.6	33	31	4,192	−12.9	54	31	4,201	−13.7	46	31	4,268	−7.6	29	31	4,177	−13.1	43	31	4,268	−8.7	----	31	4,164	−14.1	50
550	30	5,036	−8.3	----	30	4,857	−17.6	53	30	4,864	−18.3	46	31	4,942	−12.4	----	31	4,837	−17.5	38	31	4,935	−13.2	----	31	4,825	−18.1	48
500	30	5,768	−13.4	----	30	5,560	−22.8	----	30	5,565	−23.5	----	31	5,659	−17.9	----	31	5,542	−22.5	----	31	5,656	−18.6	----	31	5,525	−22.5	----
450	30	6,571	−19.0	----	30	6,329	−28.5	----	30	6,335	−29.0	----	31	6,444	−23.9	----	30	6,314	−28.2	----	31	6,436	−24.8	----	31	6,296	−28.0	----
400	30	7,428	−25.6	----	29	7,153	−35.0	----	30	7,161	−35.2	----	30	7,283	−30.7	----	29	7,143	−34.5	----	31	7,280	−30.9	----	31	7,127	−34.1	----
350	30	8,382	−32.6	----	29	8,069	−42.4	----	30	8,079	−41.4	----	29	8,213	−37.6	----	27	8,057	−41.1	----	31	8,214	−37.8	----	30	8,041	−40.6	----
300	30	9,449	−40.9	----	27	9,095	−49.6	----	27	9,107	−48.4	----	28	9,256	−45.5	----	26	9,084	−47.9	----	30	9,259	−45.2	----	29	9,080	−46.3	----
250	28	10,661	−50.3	----	27	10,273	−54.5	----	25	10,278	−54.1	----	27	10,449	−52.9	----	25	10,272	−53.6	----	28	10,457	−52.2	----	27	10,285	−52.6	----
200	25	12,087	−57.9	----	25	11,690	−54.6	----	24	11,707	−55.1	----	22	11,880	−56.3	----	18	11,689	−54.3	----	25	11,883	−57.4	----	22	11,723	−55.3	----
175	23	12,926	−60.8	----	22	12,542	−53.7	----	24	12,563	−53.6	----	17	12,726	−56.1	----	17	12,553	−53.6	----	21	12,718	−56.7	----	20	12,557	−55.2	----
150	19	13,884	−62.0	----	18	13,525	−54.3	----	22	13,555	−53.9	----	16	13,704	−57.4	----	13	13,555	−53.5	----	20	13,695	−58.0	----	15	13,491	−54.8	----
125	14	15,008	−64.7	----	11	14,696	−55.7	----	20	14,724	−55.5	----	11	14,865	−59.5	----	7	14,717	−56.3	----	13	14,825	−58.7	----	12	14,643	−56.2	----
100	12	16,350	−67.9	----					15	16,134	−57.4	----	6	16,238	−62.2	----					12	16,221	−61.3	----				
80	5	17,675	−69.5	----					8	17,534	−57.7	----									8	17,598	−60.2	----				
60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7	19,401	−59.8	----	----	----	----	----

See footnotes at end of table

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during March 1949*—Continued

Standard pressure (surface mb)	Portland, Maine (1,010.7 mb.)				Rapid City, S. Dak. (901.7 mb.)				St. Cloud, Minn. (978.3 mb.)				San Antonio, Tex. (987.0 mb.)				San Juan, P. R. (1,014.8 mb.)				Santa Maria, Calif. (1,008.5 mb.)				Sault Ste. Marie, Mich. (968.9 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	20	−0.4	72	31	960	−1.8	78	31	317	−3.5	78	31	240	16.1	72	31	15	23.4	81	31	71	11.2	82	31	221	−4.5	74
1,000	31	105	(*)	----	31	143	(*)	----	31	142	(*)	----	31	127	(*)	----	31	143	22.4	80	31	142	11.0	80	31	132	(*)	----
950	31	520	−.7	53	31	562	(*)	----	31	550	−4.1	71	31	569	15.9	62	31	589	19.0	82	31	573	8.9	73	31	535	−5.8	71
900	31	946	−2.6	52	31	995	(*)	----	31	973	−5.1	65	31	1,022	13.6	62	31	1,051	15.8	80	31	1,015	6.7	65	31	958	−6.9	70
850	31	1,398	−4.0	51	31	1,451	−.8	64	31	1,422	−5.8	58	31	1,503	12.2	52	31	1,534	13.0	77	31	1,482	3.9	64	31	1,403	−8.4	69
800	31	1,875	−5.9	50	31	1,934	−2.2	60	31	1,896	−6.9	48	31	2,010	10.8	35	31	2,042	10.3	72	31	1,973	1.4	56	31	1,872	−9.8	65
750	31	2,385	−7.7	49	31	2,449	−4.5	55	31	2,406	−8.7	44	31	2,547	8.9	27	31	2,583	8.4	57	31	2,495	−.9	46	31	2,373	−11.6	60
700	31	2,912	−9.9	47	31	2,986	−7.4	52	31	2,931	−10.6	42	31	3,113	5.5	26	31	3,147	6.6	41	31	3,038	−4.0	41	31	2,895	−13.6	55
650	31	3,488	−12.8	46	31	3,562	−10.9	54	31	3,505	−13.3	42	31	3,714	1.5	27	31	3,753	3.7	33	31	3,623	−7.5	41	31	3,463	−16.0	53
600	31	4,088	−16.1	50	31	4,169	−14.4	50	31	4,104	−16.5	44	31	4,353	−3.2	29	31	4,395	.0	----	31	4,238	−11.3	39	31	4,056	−19.1	51
550	31	4,743	−20.0	50	31	4,824	−18.6	46	31	4,755	−20.5	----	31	5,035	−8.2	32	31	5,086	−4.1	----	31	4,902	−15.4	38	31	4,701	−23.2	----
500	30	5,443	−24.3	----	31	5,527	−23.7	----	31	5,452	−25.0	----	31	5,767	−13.4	36	31	5,832	−8.8	----	31	5,614	−20.2	38	31	5,390	−27.6	----
450	30	6,210	−29.4	----	31	6,295	−29.1	----	31	6,216	−30.3	----	30	6,561	−18.9	38	31	6,647	−14.5	----	31	6,390	−28.8	----	31	6,145	−32.7	----
400	30	7,034	−35.5	----	30	7,124	−35.3	----	31	7,038	−36.3	----	29	7,428	−25.2	----	31	7,522	−20.9	----	31	7,229	−32.2	----	30	6,968	−38.1	----
350	30	7,950	−42.3	----	30	8,039	−42.7	----	31	7,951	−43.0	----	28	8,382	−32.3	----	31	8,494	−28.5	----	31	8,158	−39.0	----	29	7,879	−44.0	----
300	30	8,976	−49.0	----	28	9,064	−50.8	----	31	8,974	−49.7	----	27	9,451	−40.4	----	31	9,580	−36.7	----	31	9,198	−46.3	----	27	8,906	−50.1	----
250	29	10,151	−54.7	----	25	10,241	−55.8	----	31	10,152	−54.0	----	27	10,668	−49.5	----	29	10,817	−45.5	----	30	10,393	−53.6	----	20	10,117	−53.5	----
200	23	11,621	−55.5	----	16	11,680	−56.5	----	30	11,587	−53.5	----	22	12,104	−56.7	----	28	12,276	−55.8	----	30	11,814	−55.8	----	9	11,472	−52.2	----
175	20	12,472	−56.1	----	12	12,529	−54.4	----	29	12,446	−52.6	----	19	12,948	−59.5	----	26	13,116	−61.3	----	28	12,664	−54.7	----	6	12,341	−52.2	----
150	16	13,445	−55.2	----	6	13,508	−54.0	----	28	13,443	−52.3	----	15	13,904	−61.7	----	23	14,008	−66.9	----	27	13,650	−55.1	----	----	----	----	----
125	10	14,593	−57.3	----	----	----	----	----	24	14,616	−53.4	----	11	15,025	−63.9	----	20	15,160	−72.4	----	27	14,810	−56.9	----	----	----	----	----
100	----	----	----	----	----	----	----	----	24	16,047	−54.8	----	10	16,383	−67.4	----	14	16,472	−77.5	----	25	16,220	−59.4	----	----	----	----	----
80	----	----	----	----	----	----	----	----	16	17,493	−56.1	----	----	----	----	----	9	17,756	−76.6	----	20	17,614	−60.1	----	----	----	----	----
60	----	----	----	----	----	----	----	----	5	19,376	−55.7	----	----	----	----	----	----	----	----	----	13	19,406	−59.1	----	----	----	----	----

Standard pressure (surface mb)	Spokane, Wash. (929.9 mb.)				Swan Island, W. I. (1,013.6 mb.)				Tacubaya, Mex. (773.0 mb.)				Tampa, Fla. (1,017.7 mb.)				Tatoosh Island, Wash. (1,010.7 mb.)				Toledo, Ohio (993.9 mb.)				Washington, D. C. (1,014.2 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	721	3.2	76	31	10	24.7	77	31	2,306	18.2	39	31	9	17.4	75	31	31	7.3	79	31	191	1.1	73	31	25	7.4	60
1,000	30	125	(*)	----	31	128	24.1	78	31	31	(*)	----	31	159	18.1	69	31	116	6.6	76	31	141	(*)	----	31	141	7.0	55
950	30	548	(*)	----	31	580	20.9	82	31	498	(*)	----	31	600	16.5	58	31	538	4.7	73	31	558	1.3	66	31	565	5.3	55
900	30	986	3.4	64	31	1,043	18.1	74	31	978	(*)	----	31	1,056	14.3	50	31	975	2.2	71	31	987	−1.3	66	31	1,001	2.5	56
850	30	1,448	.8	64	31	1,531	15.4	64	31	1,477	(*)	----	31	1,537	11.5	49	31	1,434	−.7	67	31	1,442	−2.8	57	31	1,461	−.4	57
800	30	1,932	−2.3	65	31	2,044	12.8	56	31	2,008	(*)	----	31	2,042	9.0	48	31	1,916	−3.5	63	31	1,921	−4.3	50	31	1,944	−2.6	54
750	30	2,445	−5.9	67	31	2,587	10.2	44	31	2,564	16.3	39	31	2,579	6.6	38	31	2,430	−6.6	63	31	2,434	−6.1	46	31	2,462	−4.5	52
700	30	2,979	−9.1	66	31	3,155	7.8	30	31	3,146	11.7	42	31	3,137	4.0	----	31	2,959	−9.7	60	31	2,966	−8.1	41	31	2,995	−6.8	48
650	29	3,554	−12.6	62	31	3,767	5.2	24	31	3,762	6.8	48	31	3,738	.5	----	31	3,535	−12.6	57	31	3,548	−10.8	41	30	3,574	−9.9	43
600	29	4,154	−16.6	59	31	4,413	2.5	----	31	4,413	1.6	57	31	4,373	−3.5	----	31	4,135	−16.6	53	30	4,146	−15.0	42	30	4,183	−13.2	39
550	29	4,807	−20.8	----	31	5,110	−.8	----	31	5,107	−3.7	56	31	5,053	−7.8	----	31	4,789	−20.8	----	30	4,801	−19.4	40	30	4,842	−17.3	37
500	29	5,500	−25.6	----	31	5,867	−5.7	----	31	5,855	−8.2	38	31	5,790	−12.6	----	31	5,482	−25.2	----	30	5,500	−24.3	----	30	5,548	−22.1	----
450	29	6,261	−31.2	----	31	6,690	−11.6	----	30	6,678	−13.4	----	31	6,590	−18.1	----	31	6,243	−30.5	----	30	6,265	−29.5	----	30	6,317	−27.3	----
400	28	7,080	−37.4	----	31	7,577	−18.4	----	29	7,552	−19.7	----	31	7,455	−24.5	----	31	7,066	−36.5	----	29	7,082	−35.6	----	30	7,152	−33.1	----
350	28	7,989	−44.1	----	31	8,558	−25.9	----	27	8,529	−27.8	----	30	8,416	−31.7	----	30	7,979	−42.8	----	28	8,005	−41.8	----	30	8,078	−39.5	----
300	28	9,006	−51.0	----	31	9,654	−34.6	----	25	9,614	−36.7	----	29	9,487	−40.1	----	30	9,002	−49.6	----	28	9,032	−48.7	----	29	9,128	−46.1	----
250	28	10,177	−55.8	----	31	10,902	−44.3	----	23	10,852	−46.1	----	25	10,706	−49.7	----	29	10,182	−53.9	----	28	10,215	−53.9	----	29	10,321	−52.7	----
200	26	11,596	−53.5	----	31	12,363	−55.5	----	22	12,300	−56.0	----	21	12,150	−57.0	----	28	11,615	−52.7	----	28	11,640	−54.7	----	29	11,748	−55.5	----
175	25	12,458	−51.7	----	30	13,201	−60.8	----	20	13,136	−60.4	----	16	13,015	−60.3	----	27	12,479	−51.1	----	28	12,494	−54.3	----	27	12,605	−55.2	----
150	22	13,459	−51.7	----	27	14,145	−66.4	----	16	14,091	−65.1	----	12	13,989	−63.4	----	26	13,475	−50.7	----	26	13,468	−54.7	----	25	13,582	−56.6	----
125	19	14,639	−52.7	----	21	15,241	−72.1	----	14	15,184	−70.4	----	10	15,086	−68.1	----	22	14,659	−51.6	----	24	14,638	−56.8	----	23	14,720	−57.8	----
100	17	16,076	−53.9	----	11	16,522	−75.9	----	8	16,492	−75.6	----	8	16,404	−72.2	----	21	16,105	−52.7	----	15	16,047	−56.4	----	15	16,128	−59.8	----
80	12	17,506	−54.3	----	8	17,809	−75.6	----	6	17,793	−77.9	----	6	17,730	−72.6	----	16	17,548	−53.0	----	11	17,470	−57.1	----	12	17,508	−60.9	----
60	9	19,351	−54.3	----	----	----	----	----	----	----	----	----	----	----	----	----	10	19,402	−52.0	----	----	----	----	----	8	19,323	−62.4	----
50	6	20,542	−53.0	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	20,503	−63.0	----
40	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	21,879	−61.8	----

[1] Data not yet received.

*Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

NOTE.—All observations scheduled between 0300 and 0500, G. C. T. except at Ciudad Victoria, Mazatlan and Merida, where they are taken near 0200, G. C. T. "Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C.

Relative humidity data, beginning with October 1, 1948, are computed, and expressed in these tables, on the basis of the vapor pressure over water. Upper air values of relative humidity at levels with temperatures less than 0° C. have formerly been computed and expressed on the basis of the vapor pressure over ice. All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

LATE REPORTS FOR FEBRUARY 1949

TABLE 1

Standard pressure surface (mb.)	Swan Island, W. I. (1,016.0 mb.)				Standard pressure surface (mb.)	Swan Island, W. I. (1,016.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity		Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	10	24.8	78	500	28	5,879	−7.1	
1,000	28	150	24.0	79	450	28	6,679	−12.9	
950	28	599	20.6	82	400	27	7,579	−19.2	
900	28	1,063	17.4	76	350	27	8,558	−26.6	
850	28	1,550	14.4	67	300	27	9,652	−35.0	
800	28	2,060	11.4	60	250	26	10,899	−44.7	
750	28	2,602	9.5	45	200	26	12,356	−55.1	
700	28	3,170	7.2		175	25	13,195	−60.9	
650	28	3,784	6.0		150	20	14,139	−66.7	
600	28	4,430	2.4		125	9	15,210	−72.4	
550	28	5,127	−2.1						

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 2200 G. C. T. during March 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (534 m.)			Albuquerque, N. Mex. (1,627 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (505 m.)			Boise, Idaho (868 m.)			Brownsville, Tex. (7 m.)			Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (273 m.)			Denver, Colo. (1,618 m.)			El Paso, Tex. (1,198 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	103	2.2	31	232	2.9	31	263	2.3	30	354	1.4	29	304	2.8	31	23	0.7	30	113	4.3	29	254	4.0	30	299	2.1	31	224	1.8	30	242	3.4	30	76	1.6	31	255	4.3
500							31	264	3.0										30	128	4.9	29	246	5.9	30	276	2.7	31	249	3.9	30	246	4.4								
1,000	31	207	3.1				30	259	3.5				28	307	4.9	31	40	.5	24	166	3.8	23	247	9.5	30	273	5.0	28	256	5.5	28	238	5.8								
1,500	28	220	4.3				25	267	5.0	30	276	2.1	23	299	6.9	31	187	.6	17	221	2.4	17	255	11.9	26	281	7.1	26	266	7.7	27	253	8.0				31	256	4.9
2,000	27	251	6.6	31	225	4.3	23	286	8.3	29	277	4.5	18	303	9.0	30	232	1.3	12	236	5.6	13	264	14.3	21	284	9.4	24	273	10.2	19	264	10.2	30	54	1.8	30	254	4.5
2,500	25	248	9.6	31	236	4.7	20	290	10.5	27	275	6.2	16	304	10.1	25	237	1.7	12	241	8.5				18	285	12.0	23	282	12.5	17	271	13.1	28	39	.9	28	250	5.1
3,000	24	257	11.8	30	244	5.9	17	296	12.7	25	272	9.2	15	307	11.8	22	250	3.0	12	245	8.6				16	291	13.2	23	277	12.7	13	266	12.6	26	288	1.9	28	253	7.5
4,000	24	259	16.0	27	257	11.3	16	287	15.5	22	277	10.0	13	290	16.4	17	269	3.4	10	243	9.2				13	294	13.3	20	277	16.6	10	281	18.6	24	268	7.4	28	253	14.2
5,000	23	266	17.8	26	258	17.4	15	290	20.3	17	286	12.2	12	287	17.7	13	255	7.4							11	294	12.3	15	271	17.1				22	276	11.5	26	252	16.8
6,000	19	271	19.0	25	260	19.8	15	286	24.1	11	280	11.6	10	297	14.1	12	263	9.5										12	279	20.8				16	275	15.8	25	254	18.8
8,000	12	269	24.8	18	258	27.9																												13	278	22.6	18	257	24.7

Altitude (meters) m. s. l.	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (663 m.)			Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (12 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (182 m.)			New York, N. Y. (15 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	176	1.8	31	291	1.9	28	268	3.0	30	275	2.0	29	89	1.4	28	255	3.8	31	261	1.3	28	162	1.2	31	225	1.1	30	103	3.7	27	114	1.7	30	263	1.2	31	292	3.0
500							28	254	3.7				29	256	.7	28	257	4.7				28	203	2.7	31	207	1.2	30	109	2.7	27	143	1.7	30	230	2.4	31	281	5.6
1,000							28	250	4.8	30	270	3.6	29	256	3.3	22	245	5.2	31	227	1.1	26	224	3.8	31	176	2.1	29	69	.7	20	324	2.2	29	228	3.8	27	289	7.3
1,500				31	291	2.1	27	264	6.2	29	276	5.4	27	263	5.3	19	245	6.9	31	222	2.1	26	246	6.3	30	193	3.2	28	298	2.3	19	308	3.8	28	254	5.9	25	281	9.0
2,000	31	175	2.0	31	282	3.1	26	277	9.1	28	282	6.5	23	265	7.9	16	251	10.8	30	225	3.9	24	268	7.8	28	206	3.8	27	296	3.2	18	301	6.5	28	260	8.0	23	285	10.1
2,500	31	211	2.8	31	246	3.1	23	284	12.0	25	278	7.8	22	267	9.5	16	257	13.0	29	231	5.4	24	266	9.9	19	172	3.6	25	295	4.7	17	291	7.9	25	260	9.8	19	289	14.9
3,000	29	223	3.6	28	241	4.6	21	290	14.2	20	275	7.6	20	274	11.1	13	271	14.3	28	240	6.5	20	265	10.6	12	128	2.4	24	297	5.7	14	286	9.1	24	265	10.3	15	279	14.8
4,000	21	236	8.1	26	250	7.3	18	286	18.2	13	295	7.6	17	281	15.2	11	282	18.9	28	253	8.9	19	269	15.3				23	291	9.1	13	296	12.5	19	273	13.5			
5,000	16	236	11.1	21	261	9.0	13	293	16.9	11	300	8.1	14	288	16.9				28	253	11.2	15	269	18.0				19	293	12.2	11	286	15.5	17	277	16.9			
6,000	14	235	14.9	18	270	13.1	10	294	15.7				12	291	20.3				25	256	14.3	12	273	18.7				14	284	17.3				14	275	20.7			
8,000				11	283	22.9													16	263	19.8							11	277	22.3									

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Cloud, Minn. (318 m.)			St. Louis, Mo. (181 m.)			San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich. (221 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (725 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	229	3.3	28	222	4.3	27	297	0.5	31	254	1.7	31	3	4.4	26	311	2.5	28	201	1.4	29	105	1.3	31	277	4.2	24	304	3.7	28	264	0.7	27	211	0.8	29	261	3.3
500	30	238	3.4	28	218	4.7	27	228	1.7	31	254	2.4				26	312	2.8	28	229	2.9	29	135	1.5	31	288	4.1	24	302	4.0	28	197	1.8				29	264	5.1
1,000	28	228	3.2	26	213	6.0	23	234	2.9	31	246	3.6	31	2	4.5	26	300	3.6	26	236	5.3	29	158	1.6	31	277	2.8	22	307	4.5	26	191	3.1	27	239	.7	28	265	7.1
1,500	25	227	2.6	25	226	7.0	18	246	7.5	31	236	4.0	31	330	4.7	22	308	4.0	24	255	7.6	25	238	1.4	28	272	2.5	18	287	5.0	23	191	3.6	27	225	2.7	27	267	9.4
2,000	22	238	2.4	22	246	10.8	12	236	11.7	31	235	5.4	25	298	6.0	19	290	7.2	20	260	9.1	23	245	4.4	28	267	3.8	16	284	6.2	21	193	2.8	25	242	3.6	26	281	11.3
2,500	18	271	4.3	21	248	13.1	12	240	11.4	31	236	6.5	23	294	7.5	19	293	8.6	19	265	11.4	21	262	7.2	25	278	4.6	16	285	8.1	18	182	2.5	19	260	2.7	21	288	12.0
3,000	16	293	4.4	21	250	15.5	11	260	11.4	30	244	6.9	23	293	8.5	18	298	10.8	18	265	13.0	21	258	8.8	25	272	7.2	15	284	10.2	18	185	1.7	19	270	2.7	19	294	12.8
4,000	15	308	7.3	20	260	16.9	10	267	11.9	29	252	11.3	19	279	11.3	15	299	15.3	18	270	15.1	19	269	11.5	23	272	11.9	10	282	15.4	15	157	2.7	16	279	3.2	18	285	16.4
5,000	11	312	10.2	20	256	19.1				24	249	14.1	15	280	12.2	12	294	21.5	16	269	19.8	14	273	14.4	21	273	15.7							13	256	4.6	17	285	18.1
6,000				14	273	17.0				21	246	15.8	12	279	11.4				12	268	20.1	10	271	16.8	20	261	17.9							10	243	5.3	14	293	21.1
8,000										11	266	22.4													14	259	24.0											

TABLE 3.—*Free-air resultant winds based on rawin observations made near 0300 G. C. T., during March 1949. Directions given in degrees from north (N.=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,636 m.)			Big Spring, Tex. (774 m.)			Bismarck, N. Dak. (505 m.)			Brownsville, Tex. (7 m.)			Caribou, Maine (191 m.)			Charleston, S. C. (13 m.)			Columbia, Mo. (237 m.)			Grand Junction, Colo. (1,473 m.)			Greensboro, N. C. (275 m.)			Hatteras, N. C. (3 m.)			International Falls, Minn. (358 m.)			Little Rock, Ark. (80 m.)			Medford, Oreg. (401 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	270	0.5	31	154	3.6	31	353	0.8	31	109	2.7	31	290	3.1	31	243	0.7	31	204	0.2	31	284	0.6	31	298	1.5	31	314	1.9	31	308	0.9	31	171	0.6	31	147	1.7
500										31	129	5.8	31	291	5.1	30	243	3.9	31	208	2.8				31	267	3.7	31	276	4.6	31	295	1.2	30	175	3.5	30	155	1.4
1,000				30	173	6.1	31	302	3.0	31	146	5.0	31	306	5.2	29	261	4.7	31	242	5.1				31	263	5.9	31	275	5.9	31	292	2.8	31	216	5.4	30	197	1.7
1,500				30	350	6.1	31	304	5.6	31	162	3.0	30	294	5.4	29	267	6.0	31	258	6.3	31	288	.8	29	278	7.1	31	272	6.9	31	294	4.6	40	242	7.5	30	210	2.8
2,000	31	272	4.9	30	238	6.5	31	304	7.1	31	208	3.7	30	289	6.6	29	274	8.3	31	262	8.3	31	255	2.3	29	281	8.6	31	272	8.4	31	297	5.7	30	257	9.5	30	211	5.0
2,500	31	268	6.7	31	249	9.2	31	302	8.3	31	234	4.6	30	274	8.3	29	280	10.1	30	271	9.7	31	234	3.7	29	288	10.5	30	272	10.5	31	301	7.7	28	256	11.1	30	218	6.0
3,000	31	262	8.3	31	252	10.5	31	299	9.8	31	248	6.4	30	269	10.0	30	280	10.7	30	277	12.6	31	231	5.8	28	285	11.7	29	273	11.3	31	296	9.5	28	255	12.9	31	221	7.1
4,000	31	260	11.6	31	259	12.9	31	295	12.3	31	265	8.8	30	260	12.4	28	276	13.1	28	279	15.3	31	247	8.8	27	282	15.5	28	275	14.5	30	295	12.4	28	257	16.9	31	229	6.9
5,000	31	264	13.6	30	259	17.8	31	288	15.2	31	265	11.1	30	259	15.2	26	282	15.7	28	281	19.1	31	253	10.4	27	282	17.5	27	279	16.5	30	295	14.7	25	267	17.1	30	240	7.3
6,000	30	269	15.8	29	259	20.9	30	282	16.8	30	264	13.9	28	260	16.0	24	282	16.2	25	283	22.6	30	261	12.8	25	274	19.6	25	273	19.3	29	294	17.4	23	270	20.7	27	243	5.6
8,000	26	272	20.2	26	263	29.7	27	272	17.5	29	264	19.7	19	240	15.3	20	281	19.1	16	275	22.9	26	272	19.1	20	280	24.7	16	276	19.7	20	280	18.7	22	271	24.0	22	231	8.4
10,000	20	275	24.5	14	248	40.0	21	271	18.7	24	266	24.7	16	233	14.1	13	285	22.5	13	268	32.0	15	264	21.2	13	269	27.2	10	281	16.3	16	280	18.9	11	270	31.4	13	279	8.8
12,000	13	272	23.3				11	281	14.2	12	266	24.9	13	233	14.9	10	290	25.2							10	286	31.3				11	278	17.4						

Altitude (meters) m. s. l.	Miami, Fla. (12 m.)			Nantucket, Mass. (14 m.)			Nashville, Tenn. (180 m.)			New Orleans, La. (6 m.)			Oakland, Calif. (8 m.)			Oklahoma City, Okla. (392 m.)			Rapid City, S. Dak. (980 m.)			San Antonio, Tex. (242 m.)			San Juan, P. R. (28 m.)			St. Cloud, Minn. (318 m.)			Santa Maria, Calif. (72 m.)			Sault Ste. Marie, Mich. (221 m.)			Spokane, Wash. (726 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	79	1.2	28	292	2.8	31	211	0.8	31	107	1.3	31	246	3.2	30	58	1.0	31	342	1.4	30	94	2.9	31	110	2.7	31	352	1.3	31	260	2.1	31	319	2.1	26	192	0.6
500	31	96	3.3	26	281	7.5	31	215	3.2	30	127	2.6	31	230	3.8	29	123	1.1				30	108	3.5	31	98	5.4	30	319	1.7	31	299	3.0	31	309	2.6			
1,000	31	104	2.4	26	289	8.4	31	231	6.0	30	192	2.4	31	218	3.8	27	212	3.8	31	341	1.3	30	148	2.9	31	106	5.6	30	293	3.8	31	297	2.9	31	293	4.1	26	205	1.9
1,500	31	53	1.5	26	288	8.6	29	265	7.5	30	231	4.4	31	227	4.3	27	246	7.1	31	307	3.5	30	213	3.5	31	95	4.1	30	292	5.4	31	277	2.6	31	284	6.6	26	223	2.8
2,000	31	351	1.4	25	276	10.2	28	278	10.0	30	247	6.5	31	226	4.7	28	260	8.9	31	307	5.7	30	248	6.0	31	100	3.0	29	290	6.0	31	281	3.5	31	286	8.1	26	245	3.5
2,500	31	299	2.1	24	278	11.7	28	282	11.4	29	261	8.2	31	235	5.3	28	257	10.6	31	293	6.7	29	266	9.3	31	107	2.6	29	289	8.0	30	284	5.5	30	287	9.9	23	268	2.6
3,000	31	292	4.2	24	273	13.0	27	281	14.6	29	269	10.3	30	236	6.8	28	261	11.6	31	289	8.5	27	268	10.9	31	87	1.9	29	289	10.4	29	275	7.4	29	284	10.3	21	289	2.2
4,000	31	293	6.5	23	265	15.5	26	281	18.2	28	268	14.5	30	237	8.5	29	268	14.6	30	285	11.0	29	268	13.7	31	71	.3	28	291	13.8	29	273	11.6	28	284	14.6	17	273	2.5
5,000	31	286	10.4	21	267	16.9	24	277	19.4	29	274	17.8	27	244	11.0	26	267	16.1	30	291	12.5	29	267	17.2	31	273	3.0	29	289	15.9	28	268	15.4	24	280	16.2	14	266	4.7
6,000	31	291	14.0	19	269	16.5	21	276	22.1	27	271	21.7	26	260	12.3	24	270	18.7	30	286	14.7	26	268	18.9	31	275	6.0	27	286	17.6	26	271	16.9	22	285	16.8	12	279	7.3
8,000	31	290	23.8	11	267	22.7	18	279	26.3	21	279	27.4	20	268	20.5	22	268	27.6	26	279	15.4	22	271	26.5	31	285	8.7	20	278	15.6	20	268	18.9	16	262	21.3	11	265	9.9
10,000	24	290	24.4				11	275	26.9	13	272	37.2	10	263	29.1	14	268	30.5	22	277	16.7	10	284	31.0	31	280	22.8	15	258	18.5	14	251	28.8						
12,000	13	298	27.2																						29	277	31.0	12	260	17.1								
14,000																									16	278	26.2											

Altitude (meters) m. s. l.	Tatoosh Island, Wash. (33 m.)		
	Observations	Direction	Speed
Surface	29	142	2.2
500	28	193	2.8
1,000	28	188	3.4
1,500	28	198	3.7
2,000	29	207	3.7
2,500	29	214	4.3
3,000	28	213	4.6
4,000	28	232	4.6
5,000	27	215	3.3
6,000	26	250	2.7
8,000	22	322	4.2
10,000	19	332	4.8
12,000	11	290	4.9

NOTE.—Resultants prepared from rawins at high altitudes are biased toward lower wind speeds. Values appearing in this table should therefore be used with caution when the number of observations missing is greater than three. See note following table 3 in the June 1948 issue of the MONTHLY WEATHER REVIEW.

RIVER STAGES AND FLOODS FOR MARCH 1949

River stages during March averaged below normal along the Atlantic Slope and East and West Gulf of Mexico drainage areas except in Virginia and Georgia. They averaged mostly above normal in the Missouri, lower Ohio, lower Red and lower Mississippi River Basins. The greatest positive departure was at Fulton, Ark., where the Red River averaged 11.5 feet above normal.

The most significant flooding during the month was that due to ice-gorge action in the Kansas-Nebraska-Iowa-Missouri area. Extensive ice gorges in the Missouri River above Kansas City caused the highest stages of record at Nebraska City, Nebr., and Atchison, Kans., and the highest stage since 1883 at St. Joseph, Mo. A large ice gorge in the Elkhorn River at Norfolk, Nebr., caused the highest stage of record at that point. The most unusual feature of the floods in the Raccoon-Des Moines Rivers was that the thick ice cover held without breaking through the first rise except in a few local areas.

Precipitation during the month averaged mostly below normal east of the Mississippi River except in the states bordering along the main stem of the River. West of the Mississippi, it was above normal in a large area extending from the Upper Great Lakes region southwestward to California. It was also above normal in the Upper Columbia Basin and in the lower portions of the Arkansas and Red Basins. The greatest departure occurred over the central portion of the Platte River Basin in Nebraska where precipitation averaged 400 percent of normal.

The total snowfall during March and the depth of snow on the ground at the close of the month is shown in chart VII in the illustration section of the REVIEW.

St. Lawrence drainage.—Slight flooding occurred in the Upper Grand River in the Lake Michigan drainage on March 31st, and April 1st, due to the heavy rain (1.38 inches) on the last day of the month. No damage resulted from the light overflow.

Atlantic Slope drainage.—Precipitation in the Merrimack River Basin during March averaged from one-half to two-thirds of normal and was mostly in the form of rain. Above normal run-off occurred from snow-melt due to the relatively high temperatures. Only about one-half of the normal snow cover remained in the Pemigewasset basin above Plymouth, N. H., and none in the Merrimack basin below Franklin Falls, N. H., by the end of the month. A moderate rise resulted from the moderately heavy rain (0.75 inch) over the headwaters of the Pemigewasset on the 23d and 24th, with a maximum crest during the month at Plymouth, N. H., of 8.65 feet, 2.35 feet below bank-full stage.

The past winter was characterized by a very light snow cover in New England, averaging about 50 percent of normal. Most of the light snow cover in the Connecticut River Basin melted slowly during March and was not accompanied by any heavy rainfall. This condition resulted in a very orderly run-off with only moderate rises to levels 3 to 5 feet below bank-full stage. The highest stage at Hartford, Conn., was 14.5 feet, 1.5 feet below flood stage on the 30th. The only snow of consequence remaining at the end of the month was in the extreme northern tip of the Connecticut River north of the large storage reservoirs of Pittsburg and 1st Connecticut Lake.

Minor rises occurred in the Susquehanna River on the 6th–8th, and 23d–26th, due to melting of the extremely light snow cover and rainfall. The stream flow was among the lowest of record for March and the highest stage at Harrisburg, Pa. (5.8 feet) was the lowest for this month since 1916, when the sanitary dam was built.

The only significant rise in the Rappahannock Basin during the month was due to the heavy rain (1.2 inches) on the 22d and 23d when near bank-full stages were reached in the headwaters at Remington and Rapidan, Va., and about one-half bank-full in the lower portion at Fredericksburg, Va. No important rises occurred in the Potomac Basin.

A moderate flood occurred in the James River below Scottsville, Va., on the 23d to the 25th due to the heavy rain on the night of the 22d. The rain occurred over a narrow belt extending from the upper Roanoke across the Middle James River and northern tributaries and ranged from less than half an inch above Lick Run to 4.3 inches at Rockfish, Va. The rain caused an abnormally rapid rise in the middle and lower James, with a crest of very short duration. This same storm caused a rapid rise in the upper Roanoke to well above flood stage at Altavista, Va., on the 23d. The crest flattened out considerably as it moved down stream, reaching Williamston, N. C., near the mouth, on the 28th. No damage resulted from the flooding in either the James or the Roanoke.

Frequent, but not very heavy, rains occurred over the Altamaha River Basin during the month. The only flooding that occurred was at Charlotte, Ga., during the first decade.

East Gulf of Mexico drainage.—The Apalachicola River remained above flood stage at Blountstown, Fla., the entire month due to frequent rains during March. However, it is not unusual for this station to remain above flood stage for long periods while other points are below bank-full stage. No damage resulted from the overflow at this point as it did not reach a very high stage.

Heavy rains (1.73 inches) over the Cahaba River on the 31st resulted in some flooding at Centerville, Ala., on the 31st and April 1st. The rainfall was heavy over the entire Alabama River System (1.39 inches) but no other flooding occurred.

Heavy rains over the Tombigbee River system on the 22d caused sharp rises to above flood stage at Whitefield and Jackson, Ala., on the 23d and 25th, respectively. The rainfall averaged 1.5 inches in the headwaters and 2.5 inches over the middle and lower sections. Additional heavy rains on the 27th and 28th averaging about 2 inches over the headwaters of the Warrior and 2.2 inches over the upper Tombigbee resulted in flooding on the Warrior and Upper Tombigbee Rivers on the 28th. Heavy rains occurred again on the 31st. No material damage resulted from this overflow as this area had just recently been under water.

Locally excessive rain in the Pearl River above Monticello, Miss., and in the Bogue Chitto River above Franklinton, La., on the 21st and 22d, produced rises to above flood stage over the intermediate reaches. The lower reaches of the Pearl River had continued above flood stage from the vicinity of Bogalusa, La., to the coast from the previous rise. Excessive rain occurred again over the Pearl and Pascagoula Rivers on the 27th and 28th and again on the 29th and 30th. Rainfall at Jackson, Miss., during March was the heaviest since the beginning of record in 1896, 86 percent of the total occurring during the period from the 21st to the 30th.

Upper Mississippi Basin.—Minor floods developed in the Zumbro and Whitewater Rivers in Minnesota on the 5th, and 6th due to melting snow and backwater from ice

gorges. The same conditions prevailed in the Root River but flood stages were not reached. Inconvenience, however, resulted from the closing of the Brownsville, Minn., highway where floodwaters reached a depth of 3 feet. A secondary rise with additional flooding occurred on these streams during the last decade due to rain that averaged 2.75 inches during the last seven days of the month.

Conditions over the Raccoon and Des Moines River Basins preceding the flood in February and March were similar in some respects to those of 1948 and 1929. Soil moisture was already high when cold weather set in during the last few days of December, and precipitation continued above normal through January. The rivers were frozen over with ice ranging from 10 to 20 inches thick. In the latter half of February warmer weather caused some flooding from snowmelt on the Raccoon at and below Van Meter, Iowa, and on the Des Moines at Tracy and Eddyville, Iowa on February 24th. Some recession occurred but new rises began on March 2d as a result of run-off and ice gorges.

The thick ice cover held without breaking through the first rise except in a few local areas. Carrying the ice sheet unbroken, the Raccoon at Van Meter rose from below 5 feet to 13.7 feet, then receded to 10 feet; the Des Moines at Tracy rose from below 5 feet to 17.4 feet, and receded to near 11 feet; and at Eddyville the Des Moines rose to 19.7 feet, 4.7 feet above flood stage. There were sharp fluctuations in stage when the ice finally broke during the second thaw. At Tracy, the Des Moines rose from 12.8 to 18.9 feet in a few hours and receded almost as rapidly. There were several sharp rises and falls on the Raccoon at Van Meter during the ice run in the tributary streams above.

Most of the damage during this flood was the result of ice action. A highway bridge over the Des Moines at Chillicothe, Iowa, and a county highway bridge over the Raccoon were destroyed.

The light flooding along the Meramec River in Missouri on the 19th and 20th was due to rainfall averaging 0.75 inch during the 24-hour period ending at 7 a. m. on the 18th.

Gradual rises occurred in the upper Mississippi River during the first week of March as a few days of warm weather caused some melting of the heavy snow cover and ice movement beginning in the southern portion of the basin and gradually spreading northward with alternate periods of freezing and melting weather. Rather general rains about the 8–9th caused some slight flooding in the Mississippi below Keokuk Dam a few days later. A secondary rise occurred from the 13th to the 15th. Little or no damage occurred along the Mississippi as the overflow was light.

Missouri Basin.—The abnormally low temperatures during the winter as shown in figure 1 caused unusually heavy ice to form on the majority of the streams. Warm weather during the first week of March in the Missouri Basin caused increased stream flow from the melting of the rather heavy snow cover accumulated during the winter. The moderate run-off augmented by the ice break-up and accompanying ice gorges produced flooding which was locally severe throughout the Kansas-Nebraska-Iowa-Missouri area. Extensive ice gorges in the Missouri River above Kansas City caused the highest stages of record at Nebraska City, Nebr., and Atchison, Kans., and the highest stage since 1883 at St. Joseph, Mo. All the gorges in the Missouri River below Omaha, Nebr., broke by the 5th clearing out the ice in this section.

The flooding along the Floyd and Big Sioux Rivers in Iowa that began during the first week of March was due entirely to snow melt and ice break-up. Both streams were clear of ice by the 8th which was from 15 to 25 inches thick before the warm weather began on the 2d. Minor flooding occurred in the Solomon River at Niles, Kans., on the 1st and 2d.

There was considerable gorging of ice on the lower Missouri and tributaries in Nebraska during the second week, with local flooding in the Platte, Elkhorn, Republican, and the Big and Little Blue Rivers.

Ice gorge action was especially important on the Elkhorn between Norfolk and West Point, Nebr., where a succession of ice gorges formed between the 9th and 20th. A large gorge at Norfolk from the 10th to the 12th caused the highest stage of record (13.68 feet) at that point. Most of the damage from the overflows in the Elkhorn Basin was to permanent installations. Several bridge approaches and fills were damaged, especially in the western half of the Valley. Considerable loss resulted to stacked hay on the meadowlands in the Ewing-O'Neill-Atkinson district. The Norfolk city park was damaged heavily due to erosion from running water when the main channel of the Elkhorn was diverted through the park area by an ice gorge.

The severe flooding in the upper reaches of the Big and Little Blue Rivers and in the Republican near the Kansas-Nebraska line resulted from ice action and snow melt. The ice gorges were extensive in the Republican and Blue

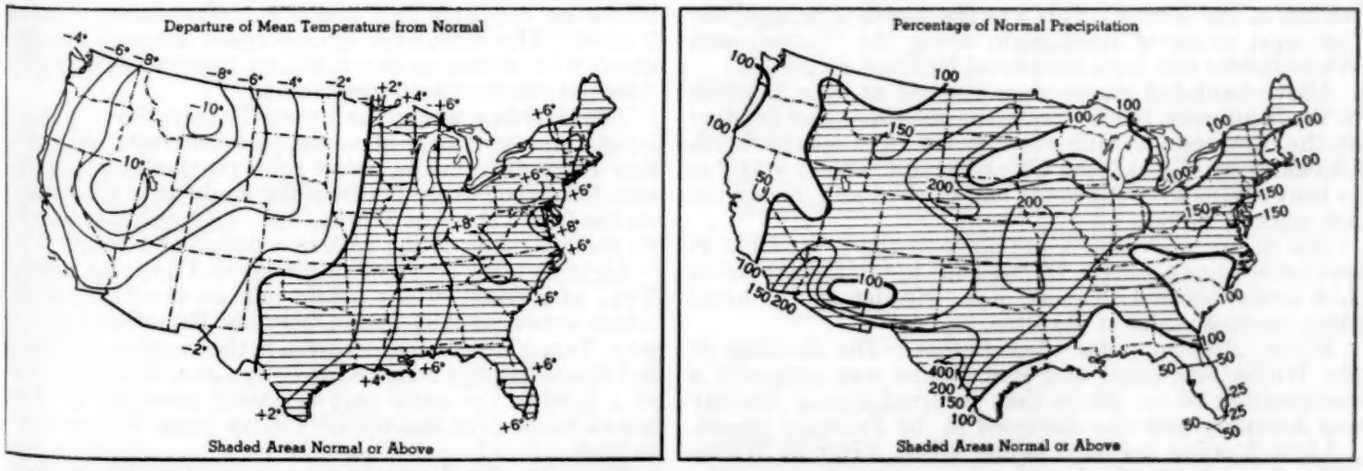

Departure of Mean Temperature from Normal
Shaded Areas Normal or Above
Percentage of Normal Precipitation
Shaded Areas Normal or Above

FIGURE 1.—Charts showing temperature departure from normal and percentage of normal precipitation in the United States for winter of 1948–49 (December-February).

Rivers. At Scandia, Kans., on the Republican, the ice jam which extended for a distance of 7 miles caused severe flooding at that point. The Missouri Pacific tracks in the lower sections of the city were inundated to depths of 3 feet. Along the Big Blue, the most severe overflow extended downstream as far as Marysville, Kans., with crests 8 to 9 feet above bank-full stage between Beatrice and Barnston, Nebr. Unusually high stages occurred in the headwaters with a record stage at Crete, Nebr.

The Yellowstone River ice started to break up about the middle of the month. It had risen to above bank-full stage in the lower portion in Montana by the 25th. There was also considerable gorging in the Platte River between North Bend and Ashland, Nebr., during this period.

By the 12th of the month, the Missouri was free of ice as far upstream as Yankton, S. Dak., and during the last decade the ice softened and broke as far upstream as Mobridge, S. Dak. By the close of the month the upper Missouri was rising but still frozen over above Mobridge, S. Dak. It was near bank-full stage in North Dakota and local flooding was occurring on the Heart, Knife, Little Missouri, and Cannonball Rivers. The lower Missouri River was near bank-full stage at and below Nebraska City, Nebr., with some local flooding occurring at that point.

Ohio Basin.—The lower Ohio River which was above flood stage at and below Mount Vernon, Ind., in the beginning of the month continued falling slowly until the 10th when a minor rise developed due to heavy rain on the 8th and 9th, averaging over 2 inches below Louisville, Ky. The only flooding that resulted occurred at Cairo, Ill. The Ohio rose 3.2 feet at that point and crested 0.5 foot above flood stage on the 15th.

Flooding on the Scioto, Green, Wabash, White, Tennessee, and lower Ohio Rivers resulted from heavy rains from the 25th to the 27th over the Ohio, Tennessee, and Cumberland Valleys.

Light flooding occurred in the Scioto River at La Rue and Piketon, Ohio, and in the Green River at Woodbury and Rumsey, Ky., due to rainfall averaging from 1 to 1½ inches on the 26th–27th.

Light flooding occurred on the lower West Fork and along the main stem of the White Rivers in Indiana due to rain and snow from the 9th to the 11th averaging between 1 and 2 inches except in the headwaters. Moderate to heavy rain (1.5 to 3 inches) occurred again between the 25th and 27th in the White and Wabash Basins causing minor flooding in the upper reaches of the White and Wabash Rivers and major flooding in the lower reaches of the White. This was the fourth time this year that vast areas of flood plain along the Wabash and White Rivers had been inundated by flood waters.

Above bank-full stages were reached at only 2 points in the Tennessee Basin during the month. The flooding on the Tennessee at Gilbertsville, Ky., and on the South Chickamauga Creek near Chickamauga, Tenn., was due to heavy rains over the lower half of the basin during the last week of March.

The rise to above bank-full stage in the lower Ohio at and below Shawneetown, Ill., was due to rainfall averaging 3.18 inches below Louisville, Ky. No damage occurred along the main stem of the Ohio.

White, Arkansas, and Red Basins.—The flooding in the White, Arkansas, and Red Basins was generally a continuation of the floods that occurred during January and February and was discussed in the February report.

Light flooding occurred in the White River at Whitecliffs, Ark., due to the heavy rain over the basin on the 21st (1.6 inches) and 26th (1.85 inches). Only slight damage occurred.

Heavy showers (1 to 2 inches) in the upper Sulphur Basin on the 21st and again on the 25th resulted in bank-full stage at Naples, Tex., on the 25th.

Lower Mississippi Basin.—After the heavy general rains of the 9th and 10th over the upper St. Francis River had poured considerable water into the reservoir above Wappapello Dam, the addition of 0.75 inch of rain on the 18th was enough to cause flooding at Fisk, Mo., and St. Francis, Ark. Rain occurred again over the basin averaging about 0.75 inch on the 22d and 2.5 inches on the 26th and 27th. The heaviest amount reported during the latter storm was 5.37 inches at St. Francis, Ark.

The Tallahatchie at Swan Lake, Miss., had receded to a stage 3–4 feet below flood stage by the middle of the month. It rose again to above bank-full stage by the 27th as a result of a series of moderate rains.

The Yazoo at Greenwood, Miss., remained below bank-full stage all month, but was rising moderately at the close of the month. It remained above flood stage at Yazoo City, Miss., during March but reached about 3 feet. Arkabutla Reservoir on the Coldwater River was less than half full on the 31st but the Sardis Reservoir on the Tallahatchie was about 80 percent full with stages near the highest of record since construction in 1939.

Rather general light to moderate rains over the Missouri, Mississippi, and Ohio Basins kept the lower Mississippi relatively full throughout the first three weeks. It remained above flood stage at and below Red River Landing, La., from early in February to about the middle of March. It went above bank-full stage at New Madrid and Caruthersville, Mo., on the 30th due to additional heavy rain in the middle Mississippi and lower Ohio on the 26th and 27th.

A break occurred in the mainline levee on the Mississippi River near Port Allen, La., across the river from Baton Rouge, early on the 24th. It was the first break of a mainline levee in this area since 1927. It occurred on a falling river so evidently was due to a sudden slide of about 600 feet of the natural bank which took with it a section of the levee. The gap was about 250 feet wide. Emergency repairs were started as soon as equipment could be brought to the scene, and by the night of the 26th the gap in the levee was closed. Approximately 25 square miles of rich sugarcane land and swamps in West Baton Rouge Parish were inundated.

West Gulf of Mexico drainage.—Minor flooding occurred in the West Gulf of Mexico drainage as a result of the heavy rains during the last decade.

The rains over the Sabine Basin in Texas averaged 1.5 inches on the 21st and about 3 inches during the last 7 days. The rains over the Louisiana streams averaged about 2.75 inches on the 21st and 22d. Only negligible damages resulted from the flooding.

The overflow along the upper Trinity River was not serious and no damage of consequence resulted. The overflow resulted from the heavy rains on the 25th and 26th that fell on soil saturated from the moderately heavy rains on the 21st. At Fort Worth, Tex., 1.40 inches of rain fell on the afternoon of the 25th in a period of 1 hour.

Light flooding occurred in the lower Trinity at Liberty, Tex., as a result of the heavy rain on the 21st and 22d which averaged 2.84 inches between Riverside and Liberty, Tex. No damage occurred in the vicinity of Liberty, but minor damage occurred at Long Lake, Tex., as a result of a flood in the early part of March resulting from the heavy rains over the upper Trinity from February 23d to 25th.

The minor floods on the Nueces and Guadalupe Rivers in Texas during the early part of March were due to rains averaging between 2 and 2.5 inches in the middle and

upper portions of the basin on February 25th and 26th. Minor flooding occurred in the headwaters of both rivers on February 26th and 27th and near bank-full stages at Gonzales and Cuero on the Guadalupe on the 27th and 28th. Damage from the flooding was minor as there were very few crops planted in the flooded area.

No material damage resulted from the slight flooding on the Rio Grande at Mercedes, Tex., March 1.

Sacramento Basin.—The second week in March brought the highest water to the Sacramento Valley since January 1946, but bank-full stages were not reached along the main streams.

Some of the creeks east of Sacramento overflowed in low places due to heavy local thundershowers on the night of of the 10th. Some damage occurred to the abutment of a bridge and a highway fill on Deer Creek near Sloughhouse, Calif. East of Sacramento, water accumulated locally where drainage was poor. Near Elk Grove, two families were marooned by local water and had to be rescued. Other than inconvenience, very little damage occurred as a result of the high water.

Heavy downpours on the 11th in the Coast Range caused the creeks west of Willows in Glenn County to become torrents. Highway 99 north of Willows was closed by a foot or more of water, halting traffic for a few hours. On the morning of the 13th the Fremont Weir began to overflow into Yolo Bypass and spread over half or more of the basin by the 24th. The Yolo Bypass road to Woodland, Calif., was closed from the 14th to the 16th.

Approximately 6,000 acres of barley was lost through the flooding. Very little damage usually results from the flooding of the Bypass lands as they are usually flooded during the winter rainy season and no farming is normally done on these unprotected lands until after the water drains off in the spring. This year there had been no water in the Yolo Bypass prior to March, so some barley had been planted.

Eel Basin.—A minor flood occurred on the lower Eel River between the 18th and 20th due to moderate to heavy rains from the 16th to the 19th. The rainfall over the basin averaged 1.5 inches during each 24-hour period. Considerable valuable topsoil was washed into the ocean but no damage occurred to buildings. The minor flood caused some damage to county roads and small bridges.

FLOOD STAGE REPORT FOR MARCH 1949

[All dates in March unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
ST. LAWRENCE DRAINAGE					
Lake Michigan					
Red Cedar: Williamston, Mich	*Feet* 7	31	31	*Feet* 7.0	31
ATLANTIC SLOPE DRAINAGE					
James:					
Bremo Bluff, Va	19	23	24	26.1	23
Columbia, Va	18	23	24	27.9	23
State Farm, Va	12	24	25	17.9	24
Richmond, Va	8	24	25	13.3	24
Roanoke:					
Alta Vista, Va	10	23	24	26.4	23
Randolph, Va	21	24	25	24.7	24
Weldon, N. C	31	26	27	35.0	26
Scotland Neck, N. C	28	27	28	28.6	27
Williamston, N. C	10	Feb. 5	Feb. 28	10.9	Feb. 16, 17
		28	Apr. 8	11.0	Apr. 1
Saluda: Pelzer, S. C	6	24	24	7.0	24
Ogeechee: Dover, Ga	7	Feb. 13	5	7.9	Feb. 16
Ocmulgee: Abbeville, Ga	11	Feb. 13	Feb. 28	12.8	Feb. 16
Altamaha: Charlotte, Ga	12	Feb. 7	10	17.7	Feb. 20, 21

See footnotes at end of table

FLOOD STAGE REPORT FOR MARCH 1949—Continued

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
EAST GULF OF MEXICO DRAINAGE					
Apalachicola: Blountstown, Fla	*Feet* 15	Dec. 1	(2)	*Feet* 23.6	Dec. 6
				20.6	Jan. 11
				20.9	Feb. 14
				18.4	1
Cahaba: Centerville, Ala	23	31	Apr. 1	27.6	31
Black Warrior:					
Tuscaloosa Lock and Dam, Ala	47	28	29	49.3	29
Lock No. 7, Eutaw, Ala	35	28	(2)		
Tombigbee:					
Aberdeen, Miss	34	28	Apr. 2	38.6	31
Columbus, Miss	29	31	Apr. 2	29.7	Apr. 1, 2
Gainesville, Ala	36	30	(2)		
Lock No. 4, Demopolis, Ala	39	Jan. 9	3	55.2	Jan. 14
				54.5	Feb. 21
		28	(2)	56.2	Apr. 6
Lock No. 3	33	Nov. 21	6	61.5	Jan. 16
				56.0	Feb. 21
		23	(2)		
Lock No. 2	46	29	(2)		
Lock No. 1	31	Jan. 6	9	40.0	Feb. 19, 20, 21
		25	(2)	38.7	Apr. 11
Bogue Chitto: Franklinton, La	11	22	25	15.2	24
Chickasawhay:					
Meridian, Miss	15	31	31	18.6	31
Enterprise, Miss	20	24	25	20.5	24
		31	(2)		
Shubuta, Miss	30	30	(2)		
Pascagoula: Merrill, Miss	22	25	29	22.4	27
		30	(2)		
Pearl:					
Edinburg, Miss	20	27	(2)		
Jackson, Miss	18			32.9	Dec. 6
		Nov. 20	7	33.1	Jan. 12
				30.5	Jan. 26
				29.5	Feb. 1
				27.8	17
		24	(2)		
Monticello, Miss	15			20.8	Jan. 7
		Jan. 5	3	22.9	Jan. 20
				20.8	Feb. 17
		22	24	16.1	23
		27	(2)		
Columbia, Miss	17			19.7	Jan. 11
		Jan. 7	Feb. 28	22.4	Jan. 23
				21.0	Feb. 19
		22	25	18.1	23
		29	(2)		
Pearl River, La	12	Nov. 24	(2)	16.7	Nov. 30
				15.0	Jan. 15
				15.8	Jan. 27
				16.1	Feb. 22
				13.4	20
				15.7	26
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Zumbro: Thielman, Minn	35	6	6	37.2	6
		25	28	37.9	28
Whitewater: Beaver, Minn	7	4	5	8.9	4
		25	25	8.1	25
Pecatonica: Freeport, Ill	10	Feb. 25	3	12.2	1
		5	12	14.3	9
Rock: Moline, Ill	10	Feb. 19	17	12.9	2
Iowa: Wapello, Iowa	10	8	15	12.8	12
Skunk: Augusta, Iowa	15	Feb. 25	1	16.1	1
Raccoon: Van Meter, Iowa	13	3	8	16.6	4
Des Moines:					
Des Moines, Iowa	13	7	7	13.0	6
Tracy, Iowa	14	5	11	19.0	5
Eddyville, Iowa	15	Feb. 24	12	19.6	Feb. 27
Ottumwa, Iowa	9	6	12	10.4	10
Illinois:					
Havanna, Ill	14	Feb. 18	11	16.6	Feb. 24–27
Beardstown, Ill	14	Feb. 18	13	18.5	Feb. 27
Meramec:					
Sullivan, Mo	11	19	19	11.4	19
Pacific, Mo	11	20	20	13.5	20
Mississippi:					
Keokuk, Iowa	12	8	14	13.3	12–13
Gregory Landing, Mo	12	9	16	13.3	11
Quincy, Ill	14	9	15	15.4	13
		7	17	15.5	13
Hannibal, Mo	13	28	28	13.0	28
		31	31	13.2	31
		Feb. 26	3	12.8	Feb. 27–Mar. 2
Louisiana, Mo	12	6	16	14.2	14
		23	29	12.8	28
		31	(2)	12.2	31
Missouri Basin					
Big Sioux: Akron, Iowa	12	4	10	17.0	8
		29	(2)	16.2	31
Floyd: James, Iowa	14	2	8	18.1	5
		25	26	16.4	26
North Fork: Pierce, Nebr	12	24	27	14.0	26
Elkhorn:					
Neligh, Nebr	10	9	10	10.0	10
Norfolk, Nebr	10	9	12	10.0	9
				13.7	11
West Point, Nebr	12	7	9	12.5	8

See footnotes at end of table.

FLOOD STAGE REPORT FOR MARCH 1949—Continued

River and station	Flood stage	Above flood stages—dates From—	To—	Crest [1] Stage	Date
MISSISSIPPI SYSTEM—continued					
Missouri Basin—Continued					
Nishnabotna:	*Feet*			*Feet*	
Hamburg, Iowa	18	6	8	23.0	7
Red Oak, Iowa	13	5	6	17.4	5
Nodaway: Burlington Junction, Mo	16	4	5	19.7	5
Platte: Agency, Mo	20	1	1	20.8	1
Solomon: Niles, Kans	24	1	2	25.4	2
Little Blue: Hanover, Kans	14	6	7	14.4	7
Big Blue:					
Beatrice, Nebr	16	5	11	24.9	8
Barnston, Nebr	18	6	12	21.9	6
				26.2	9
Blue Rapids, Kans	20	7	12	23.1	10
Grand:					
Chillicothe, Mo	18	Feb. 24	Feb. 28	27.9	Feb. 25
		31	31	22.9	31
Sumner, Mo	25	Feb. 24	1	31.2	Feb. 27
		27	28	25.6	27
		31	(2)	28.9	31
Brunswick, Mo	12	Feb. 25	2	13.7	Feb. 28–Mar. 1.
		7	11	15.0	8
		24	25	12.7	24
		28	(2)	14.9	31
Chariton: Novinger, Mo	19	Feb. 24	7	23.6	Feb. 25
				21.0	5
		27	28	21.2	27
		30	(2)	22.5	31
Marais des Cygnes:					
Osawatomie, Kans	28	31	31	28.5	31
LaCygne, Kans	25	Apr. 1	Apr. 1	25.5	Apr. 1
Missouri:					
Nebraska City, Nebr	15	Feb. 27	Feb. 28	15.1	Feb. 28
		3	7	25.8	6
		29	30	15.8	29
Browville, Nebr	15	6	9	20.5	6
		28	31	16.4	30
Rulo, Nebr	17	6	8	19.0	7
Nodaway, Mo	17	Feb. 6	8	21.0	Feb. 20, 25, 26.
				23.0	5
St. Joseph, Mo	17	Feb. 26	8	17.7	Feb. 27
				21.4	7
Atchison, Kans	20	Feb. 3	9	26.6	6
Leavenworth, Kans	19	7	8	20.0	8
Waverly, Mo	18	7	11	20.2	9
		30	31	19.2	31
St. Charles, Mo	25	10	12	25.8	10
Ohio Basin					
Scioto:					
LaRue, Ohio	11	27	28	12.1	27
Piketon, Ohio	15	27	28	17.8	28
Green:					
Lock No. 4, Woodbury, Ky	33	21	21	33.6	21
		29	30	33.9	30
Lock No. 2, Rumsey, Ky	34	Feb. 15	8	43.1	Feb. 25
		25	(2)		
West Fork:					
Muncie, Ind				6.9	27
Anderson, Ind	10	28	28	12.7	28
Spencer, Ind	14			17.8	28
Elliston, Ind	18	27	(2)	23.6	29
Newberry, Ind				17.8	30
Edwardsport, Ind	12	Feb. 15	1	20.9	Feb. 19–20
		11	16	14.6	12
		27	(2)	20.3	31
East Fork:					
Columbus, Ind				10.5	29
Seymour, Ind	14	27	30	17.0	28
Bedford, Ind				25.3	31
Williams, Ind	10	30	(2)	13.6	31
White: Petersburg, Ind	16	27	(2)	22.0	31
Wabash:					
Terre Haute, Ind	14	Feb. 16	Feb. 28	19.8	Feb. 20
Vincennes, Ind	16	Feb. 17	Feb. 28	21.0	Feb. 23–24
Mt. Carmel, Ill	17	Feb. 17	Feb. 28	23.2	Feb. 23
New Harmony, Ind	15	Feb. 19	Feb. 28	18.6	Feb. 25
South Chickamagua Creek: Chickamauga, Tenn	10	31	(2)		
Ohio:					
Dam No. 47, Newburgh, Ind	38	Feb. 17	Feb. 28	42.8	Feb. 22
Dam No. 48, near Henderson, Ky	38	Feb. 18	Feb. 28	42.2	Feb. 23
Mount Vernon, Ind	35	Feb. 18	3	40.2	Feb. 25
Dam No. 49, Uniontown, Ky	37	Feb. 19	4	42.6	Feb. 25
Shawneetown, Ill	33	Jan. 7	6	38.8	Jan. 14
				49.2	Feb. 4
				43.1	Feb. 26
		30	(2)		
Dam No. 50, Fords Ferry, Ky	34	Jan. 7	7	41.7	Jan. 15
				52.2	Feb. 4
				46.0	Feb. 26
		29	(2)		
Dam No. 52, Brookport, Ill	37	28	Apr. 6	41.2	Apr. 2

See footnotes at end of table.

FLOOD STAGE REPORT FOR MARCH 1949—Continued

River and station	Flood stage	Above flood stages—dates From—	To—	Crest [1] Stage	Date
MISSISSIPPI SYSTEM—continued					
Ohio Basin—Continued					
Dam No. 53, near Mound City, Ill	*Feet* 42	28	Apr. 8	*Feet* 47.5	Apr. 3
Cairo, Ill	40	13	17	40.5	15
		27	Apr. 9	46.7	Apr. 3
White Basin					
Black:					
Poplar Bluff, Mo	16	27	27	16.1	27
Black Rock, Ark	14	Jan. 18	7	28.5	Jan. 28
White:					
Augusta, Ark	32	29	Apr. 5	32.3	Apr. 1
Georgetown, Ark	21	28	Apr. 11	22.8	31
Des Arc, Ark	24	29	Apr. 10	25.8	Apr. 1
Clarendon, Ark	26	Jan. 22	(2)	35.3	Feb. 6
				31.5	Feb. 27
St. Charles, Ark	25	Jan. 11	(2)	33.9	Feb. 10
Red Basin					
Little Missouri: Boughton, Ark	20	28	28	20.6	28
Saline: Benton, Ark	20	10	10	20.7	10
Ouachita:					
Arkadelphia, Ark	17	10	11	22.0	11
		26	29	21.0	28
Camden, Ark	26	12	17	30.2	15
		27	Apr. 5	34.1	31
Black: Jonesville, La	50	Feb. 13	(2)	51.8	1–4
				51.9	Apr. 2
Little:					
Horatio, Ark				26.3	28
Whitecliffs, Ark	25	28	30	25.7	29
Sulphur:					
Hagansport, Tex	38	Feb. 24	1	42.2	Feb. 28
		22	22	39.3	22
		26	29	40.2	27
Naples, Tex	22	Feb. 25	7	29.0	Feb. 28
		26	(2)	26.2	31
McCartney Bridge, Tex				29.5	3
Lower Mississippi Basin					
St. Francis:					
Fisk, Mo	20	19	(2)	22.8	21, 22
				23.3	29, 30
St. Francis, Ark	18	20	(2)	21.6	27
Coldwater: Sarah, Miss	18	25	25	19.0	28
Tallahatchie: Swan Lake, Miss	26	Jan. 4	1	30.0	Jan. 9–10
				29.2	Feb. 7
		27	(2)	29.6	Apr. 2
Yazoo: Yazoo City, Miss	29	Jan. 3	(2)	36.2	Feb. 10
Mississippi:					
Red River Landing, La	45	Feb. 8	17	48.0	Feb. 23
Baton Rouge, La	35	Feb. 7	19	38.4	Feb. 22–25
Donaldsonville, La	28	Feb. 8	18	30.4	Feb. 22–24
Reserve, La	22	Feb. 9	17	23.6	Feb. 22–25
New Orleans, La	17	Feb. 9	18	18.4	Feb. 24
Atchafalaya Basin					
Atchafalaya:					
Simmesport, La	41	Feb. 15	15	42.1	Feb. 25
Melville, La	37	Feb. 6	22	39.9	Feb. 23
Atchafalaya, La	25	Jan. 17	(2)	28.8	Feb. 23–Mar. 1
Morgan City, La	6	[3] Feb. 18	31	8.0	21
WEST GULF OF MEXICO DRAINAGE					
Nezpique: Basile, La	22	25	26	22.3	26
Mermentau: Mermentau, La	50	31	Apr. 3	5.3	31
Calcasieu: Kinder, La	16	29	Apr. 6	19.6	Apr. 1
Sabine:					
Mineola, Tex	14	26	28	15.2	27
Gladewater, Tex	26	2	9	33.7	4
Bon Wier, Tex	17	28	Apr. 4	18.8	Apr. 1
East Fork: Rockwall, Tex	10	26	28	14.8	26
Trinity:					
Dallas, Tex	28	26	28	33.6	27
Rosser, Tex	26	28	31	30.1	30
Trinidad, Tex	28	31	Apr. 3	32.5	Apr. 2
Long Lake, Tex	40	3	9	42.4	5
Liberty, Tex	24	9	16	25.7	14
		22	27	25.1	26
Guadalupe: Victoria, Tex	21	1	2	22.0	1
Nueces: Cotulla, Tex	15	1	5	20.4	3
Rio Grande: Mercedes, Tex	21	1	1	21.5	1
PACIFIC SLOPE DRAINAGE					
Sacramento Basin					
Eel: Fernbridge, Calif	17.5	18	20	20.4	19

[1] Provisional.
[2] Continued at end of month.
[3] Flood stage or higher reached intermittenly.

CLIMATOLOGICAL DATA FOR MARCH 1949

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see Review, January 1948, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature							Precipitation					
			Monthly extremes							Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	54.8	−1.3	Eufaula	90	27	Valley Head	17	16	6.16	+.08	Gulf Shores	11.38	Newton	2.13
Arizona	49.5	−1.3	Tucson, Univ. of Ariz.	91	19	Fort Valley	−8	1	.51	−.57	Maverick	2.51	3 stations	.00
Arkansas	50.9	−1.6	Ashdown	84	26	Mount Magazine	18	18	5.42	+.65	Dermott	10.46	Berryville	2.09
California	48.9	−2.8	Cow Creek	89	27	2 stations	−6	1 5	4.30	+1.38	Upper Mattole	27.43	3 stations	.00
Colorado	35.1	+.6	Fruita	78	19	Taylor Park	−20	1 3	1.53	+.20	Wolf Creek Pass	4.51	Manassa	.07
Florida	65.2	−.2	Cross City Arpt	96	25	2 stations	31	1 1	2.19	−1.13	Eglin Field	8.53	2 stations	.04
Georgia	55.5	−.8	3 stations	90	1 24	Blairsville Exp. Sta.	12	16	2.98	−2.09	Suches	8.28	Brunswick	.91
Idaho	36.8	+1.1	Kuna	74	14	Island Park Dam	−20	28	1.03	−.65	Roland (W. Portal)	4.37	May R. S	.03
Illinois	41.1	+.1	3 stations	79	1 21	Stockton	5	1	3.21	+.01	Elizabethtown	8.34	Carpenter, 1 SW	1.28
Indiana	41.4	+.5	Jeffersonville	84	29	Goshen College	3	17	3.81	+.05	Evansville, WBAS	8.50	Howe Military School	.67
Iowa	34.5	−1.2	Burlington	76	29	Inwood	−4	15	2.44	+.75	Rock Rapids	4.42	Corning	1.31
Kansas	42.8	−.4	2 stations	80	1 28	4 stations	0	15	1.99	+.53	Atwood	4.28	Fredonia	.86
Kentucky	45.8	−.7	Williamsburg	86	26	Hindman Settlement School.	10	16	5.17	+.41	Uniontown Dam 49	8.47	Greenup Dam 30	2.26
Louisiana	59.1	−1.4	2 stations	87	1 6	Tallulah Delta Lab	28	19	8.25	+3.26	Naval Amn. Depot	16.13	Koran	2.33
Maryland-Delaware	44.7	+1.9	Randallstown, Md	88	27	Oakland, Md	−4	20	2.83	−.73	Salisbury Mun. Arpt., Md.	4.68	2 stations, Md	.65
Michigan	30.9	+.9	Midland Dow. Chem.	78	25	Watersmeet, U. S. Forest.	−25	19	2.05	+.05	Coloma, 2 S	5.34	White Pine Mine	.54
Minnesota	24.2	−2.5	Winona	60	1 22	Red Lake Indian Agency.	−30	1	1.71	+.49	New Ulm	5.24	Detroit Lakes	.05
Mississippi	55.7	−1.3	Wiggins	87	27	2 stations	23	1	8.45	+2.49	Natchez	14.36	Rural Hill	3.28
Missouri	43.3	−.7	Cumdenton	82	29	3 stations	4	15	3.23	−.04	Campbell	8.26	Palmyra	1.06
Montana	28.8	1−1.8	Boulder State School	68	7	Summit	−32	14	.80	−.10	Trout Creek	3.77	Chester	T
Nebraska	35.9	−.7	2 stations	77	20	Valentine, WB	−14	15	2.45	+1.31	Atkinson	6.52	Chadron	.21
Nevada	39.7	−.2	Las Vegas	85	27	Marlette Lake	−6	5	.79	−.19	Mt. Charleston Lodge	4.16	3 stations	T
New England	33.6	+1.2	2 stations, Mass	79	1 26	Fabyan, N. H	−20	20	2.22	−1.36	Tuckerman Ravine, N. H.	4.84	North Chichester, N. H.	1.02
New Jersey	42.3	+2.9	3 stations	81	27	Layton, 3 NW	−5	20	2.61	−1.20	Atlantic City	3.91	Layton, 3 NW	1.15
New Mexico	45.4	+1.8	Hagerman	88	16	Selsor Ranch	−6	2	.44	−.31	Palma	1.95	11 stations	.00
New York	33.6	+1.3	Sodus	83	28	Wanakena Ranger School.	−23	20	1.96	−1.09	Raquette Lake	5.17	Andes	.60
North Carolina	51.0	+.9	Chapel Hill	88	27	Mount Mitchell	−2	1	2.94	−1.26	Highlands	8.60	Red Springs	1.10
North Dakota	21.9	−1.9	New England	55	27	2 stations	−22	15	.60	−.18	Sherwood	1.55	Ashley	.14
Ohio	40.9	+1.8	Irontown	83	26	Millport, 2 NW	4	2	2.91	+.55	Chilo Dam 34	4.77	Put-in-Bay, Stone Lab	.45
Oklahoma	49.3	−1.3	Wichita Mt	85	24	Boise City	13	15	2.30	+.10	Fairview	6.07	Kenton	.36
Oregon	41.3	−.5	Arlington	71	19	3 stations	3	1 27	2.39	−.51	Port Orford	14.02	2 stations	.03
Pennsylvania	39.0	+1.2	Lancaster, 2 NE	86	27	Kane, 1 NNE	−8	19	1.98	−1.50	Greensburg Unity Res., 3 SE.	4.34	McConnellsburg	.37
South Carolina	54.8	.0	Ridgeland, 2 SE	90	1 26	Caesar's Head	13	16	2.09	−1.94	Sassafras Mountain	7.69	4 stations	.91
South Dakota	30.0	−1.3	Gregory	71	20	Hardy, R. S	−21	15	1.37	+.26	Fairfax	4.96	Milesville	.01
Tennessee	48.6	−.9	Newport	87	27	Point Park, Lookout Mt.	10	2	5.56	+.20	Leapwood	8.47	Lick Creek	2.51
Texas	57.6	−.9	3 stations	95	1 6	2 stations	15	15	1.78	−.21	Port Arthur, WBAS	10.21	19 stations	.00
Utah	38.7	.0	Hite	79	19	Silver Lake (Brighton)	−7	28	1.46	+.13	Alta	7.17	Callao	.09
Virginia	46.0	+.1	3 stations	86	1 27	Big Meadows	3	1	2.66	−.96	Pinnacles	5.80	Winchester Research Lab.	.92
Washington	41.2	−.6	Centralia	70	4	Bumping Lake	0	28	2.51	−.76	Clearwater	11.90	Okanogan	.36
West Virginia	42.4	−.1	2 stations	88	26	Bayard	−6	20	2.50	−1.38	Pickens No. 2	6.09	Martinsburg	.84
Wisconsin	29.6	+.2	Lake Geneva	69	29	Land O' Lakes	−22	19	2.31	+.55	Eau Claire	4.82	Marinette	.29
Wyoming	31.4	+1.6	Yoder	69	19	Lake Yellowstone	−22	28	.95	−.17	Snake River	4.20	Sarageton	.05
Alaska (Feb.)	.9	−7.0	Ketchikan	56	26	Allakaket	−58	1 9	1.50	−.37	Five Finger Light	17.21	Barrow	.08
Hawaii	67.7	−1.1	Mahukona	88	1 11	Haleakala R. S	32	15	6.37	−3.06	Kukui	44.00	7 stations	.00
Puerto Rico	74.0	−.1	Caguas	92	13	Garzas Dam (2)	48	1 13	4.20	+1.02	Humacao	16.19	Yauco	.13

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR MARCH 1949

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [6]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover, [7] tenths (sunrise to sunset)	Possible sunshine
NEW ENGLAND	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m.p.h.					0-3	4-7	8-10	0-10	%
Caribou [2]	628	5	33	988.5	1,010.5	.....	32	14	33.2	+3.0	48	26	−10	8	1,317	15	67	2.44	−1.3															6.3
Eastport	75	67	82	1,009.5	1,012.2	−.7	38	26	22.6	+.8	58	28	10	20	1,031	.....	72	2.48	+.1	.71	15	0	14.4	8	15.6	nw.	.....	.....	.....	6	9	16	6.8	...
Portland, Me. [2]	103	6	43	1,010.2	1,012.7	−.8	43	24	31.7	+2.8	58	28	4	20	986	24	70	3.15	−.7	.77	17	0	19.8	0	11.9	w.	33	e.	1	7	4	20	7.2	46
Concord [2]	289	5	45	1,001.0	1,013.7	−.5	45	24	33.2	+2.1	69	26	4	20	986	24	70	2.04	−1.8	.69	14	1	7.5	0	9.2	nw.	39	nw.	1	9	7	15	6.1	47
Mt. Washington	6,274	5	37	976.5	1,015.6	.....	34.8	+5.7	74	26	5	20	939	21	60	1.20	−1.8	.38	10	0	5.5	0	9.5	wnw.	29	nw.	1	8	8	15	6.1	48
Burlington [2]	403	6	51	1,001.7	1,014.5	−.4	40	22	31.0	+1.9	64	27	−2	20	1,057	22	70	3.79	−3.4	.77	17	0	16.7	0	40.0	nw.	.....	.....	.....	6	6	19	7.2	32
Boston [2]	124	33	62	1,012.5	1,013.6	−.6	47	31	39.2	+3.6	71	26	13	20	799	24	58	1.40	−.6	.43	11	0	7.5	0	10.6	nw.	45	s.	5	5	11	15	6.8	45
Nantucket [2]	12	4	34	1,013.2	1,013.6	−.3	43	32	37.7	+2.2	59	28	18	20	850	31	79	1.66	−1.9	.54	6	0	9.9	0	14.0	sw.	44	n.	1	9	5	7	6.2	61
Block Island	26	11	46	1,013.5	1,014.3	−.3	43	32	37.8	+2.4	61	28	18	20	839	30	74	3.34	−.4	1.28	10	0	1.6	0	17.4	sw.	47	n.	1	9	4	18	6.5	47
Providence [2]	159	65	60	1,011.9	1,014.0	−.6	49	32	40.4	+4.7	72	27	10	20	765	25	61	3.55	−.3	1.08	11	0	8.2	0	19.2	nw.	57	nw.	14	12	6	13	5.6	60
Hartford [2]	159	5	44	1,014.2	1,014.7	−.5	48	29	38.5	+3.5	72	26	2	20	825	26	64	2.37	−1.5	.59	8	0	15.8	0	11.3	n.	30	s.	22	10	6	15	6.1	65
New Haven [2]	107	5	39	1,014.6	1,014.7	−1.2	47	31	38.8	+4.3	66	28	8	20	811	27	62	1.95	−1.8	.52	8	0	8.4	0	7.8	n.	29	s.	23	12	6	13	5.5	64
MIDDLE ATLANTIC																	62	2.38	−1.1														6.0	
Albany [2]	97	6	40	1,003.7	1,014.7	−.9	45	26	35.6	+5.8	73	27	6	20	910	24	65	1.07	−1.6	.50	9	0	7.8	0	11.6	s.	42	w.	13	3	10	18	7.2	64
Binghamton [4]	871	57	79	984.4	1,015.9	+.3	46	28	37.0	+4.4	75	27	6	20	872	25	68	1.56	−1.1	.43	17	1	3.4	T	7.3	w.	26	w.	11	4	7	20	7.7	32
New York [4]	314	415	454	1,014.6	1,016.1	+.5	51	34	42.4	+4.7	73	27	16	19	701	28	59	1.97	−1.7	.71	7	0	4.2	0	17.5	nw.	54	nw.	1	11	7	13	5.7	68
Allentown [2]	385	4	58	1,002.0	1,016.2	.....	51	29	40.0	+2.3	80	27	6	20	772	28	63	1.39	−2.1	.55	8	0	2.7	0	10.2	w.	.....	.....	.....	8	9	14	6.2	...
Harrisburg [2]	374	30	49	1,017.3	1,016.4	−.2	52	33	42.3	+3.4	78	30	18	20	709	27	58	1.20	−1.8	.61	8	0	6.2	0	10.3	wnw.	36	nw.	12	9	7	15	6.4	66
Philadelphia [4]	114	174	150	1,015.2	1,016.2	−.4	53	36	44.7	+3.9	78	30	20	19	637	30	62	3.17	−.2	1.03	11	0	1.7	0	9.2	w.	29	nw.	1	11	7	13	5.4	64
Reading	323	47	306	1,004.4	1,016.6	+.3	53	34	43.6	+3.0	82	27	15	20	672	.....	...	1.82	−1.7	.69	9	0	2.5	0	13.9	nw.	49	w.	12	9	8	14	6.0	65
Scranton	805	72	104	986.1	1,015.6	−.3	47	30	38.6	+2.9	77	27	8	20	820	.....	...	1.50	−1.7	.49	8	0	5.4	0	7.5	n.	31	nw.	1	6	12	13	6.2	49
Atlantic City	52	37	172	1,013.9	1,016.1	−.2	48	36	41.9	+3.3	67	28	20	1	717	32	70	3.91	+.3	1.24	12	0	T	0	18.5	n.	47	nw.	1	12	5	14	5.4	69
Newark [2]	30	5	46	1,014.6	1,015.4	.....	52	33	42.5	+2.9	78	27	15	20	704	28	59	1.95	−2.0	.70	6	0	6.4	0	12.8	wsw.	.....	.....	.....	11	6	14	5.8	...
Trenton	190	89	107	.....	.....	.....	52	34	42.8	+3.7	76	27	17	19	690	.....	...	2.76	−.6	.76	8	0	6.0	0	10.9	nw.	32	nw.	1	12	7	12	5.4	61
Baltimore [4]	123	100	215	1,016.3	1,018.3	+1.7	55	38	46.6	+4.3	82	27	23	1	578	31	60	2.74	−1.0	1.15	9	1	T	0	13.1	s.	66	w.	12	9	13	9	5.5	59
Washington [4]	112	56	100	1,014.9	1,017.0	+.4	56	38	47.2	+4.6	83	27	23	1	565	31	58	3.96	+.2	1.31	10	2	T	0	9.1	nw.	35	nw.	1	8	12	11	6.0	59
Cape Henry	18	8	54	1,015.2	1,015.9	−.4	57	41	49.0	+2.4	85	27	27	1	512	.....	...	2.74	−1.1	1.23	12	5	T	0	14.7	n.	49	nw.	11	11	8	12	5.5	62
Lynchburg [2]	686	5	58	983.4	1,017.1	−.2	58	36	46.9	+1.5	80	27	19	1	566	32	59	3.49	−.1	2.43	10	0	T	0	8.0	sw.	29	w.	10	8	10	13	6.1	61
Norfolk [4]	91	80	125	1,016.3	1,017.4	+.1	60	41	50.9	+2.7	84	27	26	1	460	36	63	2.85	−.9	1.11	11	3	T	0	11.1	n.	37	nw.	11	9	9	13	6.0	71
Richmond [4]	144	11	52	1,010.5	1,016.8	−.1	60	38	49.2	+2.0	84	27	23	16	508	34	61	2.34	−1.3	.96	11	2	.4	0	8.9	sw.	29	nw.	1	11	8	12	6.0	65
SOUTH ATLANTIC																	65	1.85	−1.9														5.6	
Asheville [4]	2,253	77	92	.....	1,018.1	+.1	58	36	47.0	+2.1	77	26	16	16	562	35	...	3.32	−.6	.88	13	0	T	0	9.8	nw.	34	nw.	10	10	6	15	6.0	66
Charlotte [4]	779	63	86	989.8	1,017.8	+.5	64	42	53.1	+2.7	82	27	25	1	395	37	59	2.35	−1.8	.55	8	3	T	0	7.8	sw.	26	w.	18	10	5	16	6.2	68
Greensboro [2]	886	6	56	985.4	1,018.1	+1.5	62	37	49.4	+2.3	81	27	20	2	499	34	60	2.45	−1.9	.95	10	3	T	0	9.9	sw.	31	nw.	15	11	4	16	5.9	64
Hatteras	11	5	47	1,017.6	1,017.8	+.9	58	46	52.2	+.2	76	28	30	1	401	46	79	2.27	−2.0	1.01	10	3	T	0	13.7	ne.	42	nw.	1	9	10	12	5.9	81
Raleigh [4]	376	5	71	1,001.7	1,017.8	+.5	64	40	52.0	+1.8	85	27	23	1	433	38	63	1.77	−2.1	.50	9	3	.0	0	8.3	sw.	26	sw.	18	9	11	11	5.5	47
Wilmington [4]	72	73	107	1,016.9	1,018.4	+.4	65	46	55.2	+1.9	81	28	29	16	337	43	...	1.66	−1.5	.51	8	5	.0	0	10.9	sw.	44	s.	18	8	15	8	5.2	74
Charleston [4]	48	11	92	1,016.6	1,018.3	+.3	66	49	57.8	+.4	82	28	33	16	263	45	67	1.60	−1.4	.80	7	2	.0	0	10.8	s.	37	n.	7	11	10	10	5.2	73
Columbia, S. C. [4]	347	70	91	1,009.8	1,018.1	+.1	67	46	56.5	+1.3	85	27	28	1	312	41	63	1.04	−2.4	.36	7	2	.0	0	9.1	n.	29	sw.	10	12	7	12	5.3	79
Greenville, S. C. [2]	1,040	18	36	979.0	1,017.5	+1.2	63	42	52.6	+2.7	80	26	23	16	400	38	62	2.63	−2.5	1.08	12	3	T	0	8.8	sw.	50	sw.	10	10	7	14	5.9	69
Augusta [4]	182	62	77	1,002.4	1,018.2	+.9	69	46	57.2	+1.2	87	27	29	16	289	39	56	1.25	−2.9	.39	9	0	.0	0	6.6	s.	33	nw.	15	11	6	14	5.6	68
Savannah [2]	65	19	51	1,016.6	1,018.8	+.8	70	48	59.2	+2.1	83	25	33	1	239	47	68	.92	−2.1	.61	5	2	.0	0	11.1	sse.	40	w.	10	10	11	10	5.4	62
Jacksonville [4]	43	86	110	1,017.6	1,018.8	+.5	74	53	63.4	+.8	87	26	36	1	147	51	71	.99	−1.9	.66	8	1	.0	0	8.8	ne.	40	w.	10	12	10	9	4.9	62
FLORIDA PENINSULA																	68	1.12	−1.0														3.7	
Key West [4]	21	10	64	1,016.6	1,017.4	+.1	80	68	70.6	+1.0	84	28	60	2	0	64	72	.41	−1.0	.20	4	0	0	0	9.5	e.	27	nw.	7	16	11	4	3.6	74
Miami [4]	25	242	249	1,016.9	1,017.6	−.7	76	64	69.9	+.4	81	24	50	1	16	59	68	2.72	+.1	2.42	7	1	.0	0	14.7	se.	37	ne.	7	14	13	4	3.8	82
Tampa [2]	35	5	36	1,017.6	1,018.2	−.1	80	56	68.0	+1.2	91	24	44	8	41	53	64	.22	−2.2	.22	1	1	.0	0	8.1	n.	28	s.	28	16	10	5	3.7	81
EAST GULF																	68	6.89	+1.5														6.2	
Atlanta [2]	1,173	33	72	983.1	1,018.1	+.1	64	42	57.8	−.1	83	26	24	1	386	38	61	4.32	−1.1	1.60	12	2	.0	0	12.0	nw.	40	w.	10	9	6	16	6.1	68
Macon [4]	370	79	87	1,005.1	1,018.4	+.4	67	44	53.2	+1.2	84	26	27	16	321	42	61	2.74	−2.2	1.01	11	5	.0	0	7.3	n.	33	nw.	15	12	3	16	5.7	57
Apalachicola	35	11	51	1,016.9	1,018.3	+.7	68	54	55.8	−.9	84	26	27	16	321	42	61	2.74	−2.2	1.01	11	5	.0	0	7.3	n.	33	nw.	15	12	3	16	5.7	57
Pensacola [4]	56	54	79	1,016.3	1,018.6	+.3	69	53	61.2	−.4	78	31	39	1	159	.....	...	2.44	−1.8	.80	10	4	.0	0	8.6	se.	34	se.	22	11	6	14	5.5	67
Anniston	618	6	32	996.3	1,018.7	+.7	66	40	60.6	+.3	77	27	36	1	175	51	...	9.66	+4.9	4.00	13	6	.0	0	8.8	s.	44	se.	22	10	6	15	6.1	65
Birmingham [2]	700	5	63	995.6	1,018.6	+.3	66	42	53.0	.....	84	26	23	16	388	42	69	5.80	+.2	1.87	11	3	.0	0	7.8	ene.	37	s.	21	7	10	14	6.5	...
Mobile [4]	57	86	161	1,010.2	1,018.3	+.3	69	51	53.8	.0	83	26	26	1	368	41	66	7.98	+2.3	1.63	11	7	.0	0	10.8	n.	40	se.	21	7	10	14	6.3	51
Montgomery [4]	218	92	105	1,010.8	1,018.5	+.2	68	47	60.1	+.4	81	25	35	19	193	50	74	5.93	.0	1.47	13	6	.0	0	12.1	n.	65	se.	30	10	8	13	5.6	55
Meridian [4]	375	67	92	1,007.1	1,018.4	+.8	69	44	57.8	.0	85	26	31	1	269	44	67	4.56	−1.4	1.15	11	4	.0	0	7.3	n.	24	w.	10	9	9	13	6.0	60
Vicksburg [4]	247	82	102	1,008.5	1,017.7	−.3	67	47	56.6	−.5	84	25	30	4	285	45	71	10.38	+5.2	4.22	12	9	T	0	8.2	s.	.....	.....	.....	7	9	15	6.5	...
New Orleans C. O.	53	76	84	1,015.6	.....	.....	71	54	57.4	−1.1	82	26	35	19	257	46	...	8.90	+3.3	3.30	12	9	T	0	9.9	n.	34	w.	9	5	8	18	7.4	47
New Orleans A. P. [2]	30	6	52	1,015.6	1,017.7	+.1	71	52	62.7	−.1	83	26	40	19	143	.....	...	11.83	+7.1	6.42	13	3	T	0	7.5	se.	26	se.	21	10	8	13	5.7	63
WEST GULF									61.8	.....	82	30	39	4	164	53	75	8.13	.....	.....	12	7	T	0	9.2	ne.	.....	.....	.....	7	7	17	6.7	...
Shreveport [2]	181	5	64	1,009.8	1,016.9	.0	69	46	60.8	+.3	80	30	34	3	244	49	73	3.17	+.4															6.8	
Fort Smith [2]	463	6	30	999.3	1,016.0	−.3	63	40	57.4	−1.0	80	29	28	2	410	39	74	2.94	−1.2	.87	10	6	T	0	10.5	sse.	57	s.	21	5	7	19	7.2	52
Little Rock [2]	265	26	58	1,004.1	1,017.5	+.6	62	42	51.8	−.8	79	29	28	2	410	39	66	3.32	+.3	1.47	8	4	.7	0	9.0	ene.	38	e.	25	7	8	16	6.7	58
Austin [2]	621	5	41	993.2	1,015.8	+.6	72	49	52.0	−1.0	77	30	32	1	408	42	69	7.33	+2.7	2.87	9	8	T	0	9.4	se.	38	nw.	9	6	10	15	6.3	47
Brownsville [2]	20	5	54	1,010.8	1,013.5	−.7	78	63	60.5	−.2	83	6	35	3	172	50	72	2.24	−.1	1.28	7	4	.0	0	9.3	se.	32	nw.	9	7	9	15	6.6	57
Corpus Christi [2]	44	6	33	1,012.9	1,015.2	−.4	75	59	70.2	+2.0	91	30	49	2	36	63	82	.41	−1.2	.26	5	2	.0	0	13.0	sse.	35	s.	17	4	10	17	7.4	22
Dallas [2]	488	34	45	997.6	1,015.9	−.4	67	46	66.8	+3.8	89	21	45	3	67	59	78	1.62	.0	.82	6	5	.0	0	12.9	sse.	37	n.	26	4	7	20	7.4	44
Fort Worth [2]	706	40	56	990.5	1,016.0	+.1	68	46	56.7	−.7	79	24	32	18	288	45	68	2.76	−.1	1.51	7	1	T	0	11.0	s.	38	sw.	26	9	11	11	6.5	50
Galveston [4]	54	122	129	1,015.6	1,016.3	−.6	68	58	57.0	+.3	78	24	31	18	255	43	64	3.69	+1.4	2.37	6	4	T	0	15.6	sse.	.....	.....	.....	8	7	16	6.3	...
Houston [4]	138	157	190	1,013.5	1,016.4	−.5	71	55	63.2	+.8	80	21	42	2	111	58	83	3.04	+.4	1.23	7	6	.0	0	13.4	e.	45	w.	21	4	13	14	7.0	43
Laredo [2]	418	10	38	994.9	1,013.8	.....	80	59	63.2	−.1	85	6	40	1	127	56	79	3.05	−.4	1.07	12	9	.0	0	11.4	se.	37	se.	21	4	10	17	7.2	41
Palestine	510	64	72	998.0	.....	.....	69	49	69.4	+1.6	93	25	45	1	50	53	62	2.85	−.6	1.43	10	4	.0	0	10.5	se.	.....	.....	.....	4	7	20	7.5	...
Port Arthur [4]	34	59	134	1,015.2	1,016.4	−.2	70	55	58.8	−.3	78	6	34	2	210	.....	...	2.85	−.6	1.43	10	4	.0	0	8.3	s.	29	se.	21	8	9	14	6.3	63
San Antonio [2]	794	6	51	986.8	1,015.3	−.3	73	51	62.2	−.6	90	6	36	10	130	50	69	2.27	+.4	1.27	8	2	T	0	9.4	se.	40	w.	13	7	6	18	6.8	54

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR MARCH 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Temperature of the air: Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [2]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover, [7] tenths (sunrise to sunset)	Possible sunshine
OHIO VALLEY AND TENNESSEE	*Ft.*	*Ft.*	*Ft.*	*Mbs.*	*Mbs.*	*Mbs.*	*°F.*	*°F.*	*°F.*	*°F.*	*° F.*		*° F.*			*° F.*	%	*In.*	*In.*	*In.*			*In.*	*In.*	*m. p. h.*					*0-3*	*4-7*	*8-10*	*0-10*	%
									44.8	+1.5							69	4.31	+.1															7.0	
Chattanooga [2]	762	6	66	993.2	1,018.5	+.5	64	39	51.5	+2.4	81	26	20	16	432	38	65	5.26	−.5	1.18	13	5	T	0	6.4	s.	34	w.	10	7	7	17	6.5	44
Knoxville [2]	995	27	71	979.3	1,018.5	+.9	61	38	49.4	+1.9	83	26	19	16	491	36	64	5.06	.0	1.66	12	4	T	0	9.4	sw.	38	nw.	6	7	6	18	6.7	51
Memphis [2]	399	5	49	1,007.1	1,017.8	+.2	60	43	51.6	−.7	77	24	27	1	433	40	68	5.42	+.2	1.82	10	6	T	0	8.6	se.	34	sw.	9	6	10	15	6.7	56
Nashville [2]	546	5	72	995.9	1,018.0	.0	60	39	49.5	+.3	79	24	21	1	493	38	67	5.46	+.4	1.59	12	4	T	0	9.4	sse.	34	se.	21	7	6	18	6.8	50
Lexington [2]	989	4	58	982.1	1,018.2	+.6	54	34	44.2	+.5	76	26	16	16	649	34	70	5.06	+.7	1.35	13	3	3.9	0	11.3	sw.	...	.....	...	3	11	17	7.2	...
Louisville [2]	525	5	54	999.7	1,017.7	+.8	57	36	46.2	+2.1	78	24	19	1	589	35	67	5.65	+1.3	1.78	14	1	2.6	0	9.3	ese	42	sw.	22	5	10	16	7.1	56
Evansville [2]	431	6	40	1,003.7	1,018.0	+.4	55	35	45.0	+.6	76	25	18	1	628	36	72	8.50	+4.3	3.03	13	5	5.8	0	9.5	nnw.	34	s.	21	7	12	12	6.5	56
Indianapolis [2]	823	5	54	987.5	1,017.5	+.9	51	31	41.0	+2.2	74	25	16	7	744	33	72	3.16	−.8	1.72	10	2	5.1	0	11.7	wnw.	47	sw.	27	3	8	20	7.2	46
Terre Haute [2]	575	4	36	995.6	1,017.8	+1.2	52	32	41.8	+1.2	73	25	17	1	717	33	71	2.99	−.8	1.43	13	4	1.6	0	11.6	sse.	48	s.	21	6	10	15	6.8	55
Cincinnati [4]	627	135	148	985.4	1,018.0	+.7	55	37	45.9	+3.1	77	25	22	16	596	33	69	3.86	.0	1.66	11	2	3.1	0	5.4	nw.	17	nw.	31	4	10	17	7.2	54
Columbus [4]	822	90	110	986.8	1,017.5	+.6	50	34	42.0	+2.9	76	30	16	1	711	32	71	2.80	−.7	.91	12	0	1.7	0	10.9	sw.	39	sw.	27	5	8	18	7.1	57
Dayton [2]	1,003	6	55	980.7	1,017.6	+1.3	49	32	40.2	+1.5	73	25	17	16	770	31	72	3.31	−.4	1.27	11	3	6.4	0	12.5	s.	45	s.	27	5	7	19	7.2	49
Elkins [2]	1,947	5	45	944.8	1,018.0	+.4	50	28	39.2	+.1	78	24	11	1	796	30	72	3.02	−.8	1.03	16	0	7.8	0	7.9	wnw.	32	wnw.	6	5	5	21	7.6	46
Parkersburg	637	77	84	.....	.....	.....	54	34	43.9	+1.1	78	3	17	1	654	...	...	2.03	−1.5	.67	16	0	2.8	0	7.6	nw.	28	e.	27	6	8	17	7.1	41
Pittsburgh [2]	842	39	54	970.2	1,016.7	+.1	50	31	40.6	+3.4	76	27	15	1	758	29	65	3.14	+.1	.70	21	0	6.1	0	11.2	nw.	36	s.	27	3	7	21	7.5	45
LOWER LAKES																																			
									35.4	+2.9								2.23	−.5															7.5	
Buffalo [2]	768	34	96	987.5	1,016.4	+.8	42	26	33.6	+2.3	70	25	7	20	961	25	72	2.52	−.1	.77	16	0	14.3	T	15.1	sw.	49	sw.	27	1	7	23	8.0	54
Canton	448	10	61	998.3	1,014.9	+.3	38	19	29.0	+1.2	66	27	−2	20	1,117	20	70	2.00	−.5	.39	17	0	14.5	0	9.0	w.	34	w.	28	4	10	17	7.3	52
Oswego	335	71	85	1,003.1	1,015.6	.0	41	28	34.8	+3.7	73	27	14	7	938	...	...	1.41	−1.2	.41	17	1	7.2	0	11.1	w.	35	nw.	12	0	6	25	8.4	31
Rochester [2]	523	4	69	994.9	1,016.0	+.1	43	25	34.1	+2.3	78	27	7	2	956	25	72	1.89	−.9	.43	19	0	13.7	2	12.4	wsw.	49	sw.	28	4	8	19	7.5	55
Syracuse [2]	596	5	57	1,000.7	1,016.1	+.5	44	26	35.4	+5.7	76	27	8	19	917	26	68	2.34	−1.0	.83	18	0	17.0	T	10.7	ene.	36	s.	22	1	9	21	8.0	48
Erie [4]	714	57	81	.....	.....	.....	43	30	36.7	+3.2	71	27	16	20	878	...	...	3.28	+.7	1.29	18	1	12.4	0	9.5	w.	29	sw.	28	3	8	20	7.6	39
Cleveland [2]	762	27	54	988.2	1,016.9	+.6	46	29	37.1	+2.6	73	29	11	2	862	29	73	2.66	−.1	.69	18	1	13.2	0	13.6	wsw.	39	w.	27	3	9	19	7.4	44
Sandusky	629	5	67	993.9	.....	.....	46	30	38.0	+2.9	75	25	17	16	836	...	...	2.10	−.6	.75	11	0	7.1	0	10.8	sw.	33	sw.	27	6	10	15	6.6	44
Toledo [2]	628	5	47	993.2	1,017.0	+.4	46	28	36.6	+2.8	74	25	12	17	878	28	71	1.82	−.7	.67	10	1	6.2	0	13.8	sw.	50	sw.	27	5	10	16	7.3	54
Fort Wayne [2]	857	5	34	986.1	1,017.2	+.6	47	29	38.1	+2.0	72	29	15	17	833	29	72	1.86	−1.4	.52	12	2	2.0	0	9.9	nw.	38	sw.	27	3	8	20	7.5	55
Detroit [2]	730	5	77	993.6	1,017.1	+.8	44	28	35.7	+2.7	73	25	13	1	909	25	66	2.60	+.2	1.52	10	1	2.1	0	12.5	nw.	38	sw.	27	5	7	19	7.4	43
UPPER LAKES																																			
									29.9	+2.5								2.31	+.2															7.2	
Alpena	609	5	89	993.2	.....	.....	36	22	29.0	+3.5	61	25	7	1	1,118	...	...	.90	−1.1	.39	12	2	3.7	0	11.6	nw.	33	sw.	25	4	8	19	7.5	43
Escanaba	612	51	72	993.2	.....	.....	34	21	27.6	+3.4	49	28	8	19	1,159	...	...	1.86	.0	.94	11	0	.7	0	12.0	nw.	36	ne.	31	4	10	17	7.4	36
Grand Rapids [4]	707	70	244	990.9	1,016.7	+.4	42	25	33.7	+3.0	67	21	−4	17	974	26	74	2.28	−.2	1.05	10	2	7.6	T	11.9	nw.	61	sw.	27	4	7	20	7.5	48
Lansing [4]	878	5	90	984.1	1,016.9	+1.0	42	26	33.8	+2.2	71	29	10	1	965	25	72	2.61	+.3	1.49	11	0	3.9	0	15.2	sw.	42	ne.	31	7	6	18	7.4	41
Marquette	734	44	73	988.5	.....	.....	33	21	26.8	+2.0	52	4	6	6	1,185	...	...	2.20	−.1	1.19	12	0	5.7	T	9.0	nw.	35	sw.	7	1	5	25	8.5	41
Sault Ste. Marie [2]	614	10	52	988.2	1,016.2	−.4	31	15	23.0	+2.4	47	26	−10	1	1,302	17	76	1.67	−.1	.48	12	1	5.5	T	11.9	nw.	43	sw.	25	2	9	20	8.0	59
Chicago [2]	673	5	38	993.6	1,016.9	+.3	46	29	37.5	+3.0	73	29	13	15	854	27	69	3.32	+.8	1.72	11	3	.6	0	11.3	nw.	36	w.	27	7	8	16	6.9	58
Green Bay	617	5	32	993.6	.....	.....	38	23	30.5	+1.9	58	21	8	1	1,069	...	...	3.75	+1.7	1.63	11	5	11.1	7	9.7	s.	28	sw.	27	6	11	14	6.7	48
Milwaukee [2]	681	33	66	990.5	1,016.8	+.9	41	26	33.4	+3.3	65	21	10	1	983	24	70	2.57	+.2	1.37	9	1	3.7	T	14.9	wnw.	45	sw.	25	7	8	16	6.6	49
Duluth [4]	1,133	5	47	964.1	1,017.2	+.6	32	16	24.1	+.4	50	26	−3	14	1,267	14	74	1.93	+.4	.79	7	3	12.1	T	12.9	w.	40	sw.	7	11	7	13	5.5	58
NORTH DAKOTA																																			
									22.0	+.2								.54	−.3															7.2	
Fargo [2]	940	5	47	983.7	1,018.4	+1.1	30	14	22.1	−.6	41	31	−10	9	1,329	18	82	.36	−.6	.24	5	0	2.1	T	12.9	n.	31	w.	25	4	10	17	7.2	51
Bismarck [2]	1,677	5	41	956.3	1,018.8	+1.2	32	16	24.0	+2.1	48	27	−5	14	1,269	18	79	.31	−.6	.22	4	0	1.4	0	10.2	wnw.	33	w.	27	6	7	18	7.1	54
Devils Lake	1,478	11	44	962.8	.....	.....	26	8	17.4	−2.4	38	29	−14	14	1,478	...	...	.77	.0	.39	8	0	8.4	0	8.3	sw.	26	n.	7	6	7	18	7.0	44
Williston	1,878	42	50	947.5	.....	.....	33	16	24.5	+1.6	48	31	−7	14	1,253	...	...	.73	.0	.44	9	0	5.2	T	6.0	w.	23	nw.	7	6	3	22	7.7	68
UPPER MISSISSIPPI																																			
									37.0	+1.1								3.00	+.6															7.1	
Minneapolis-St. Paul [2]	919	43	74	985.1	1,017.0	+1.4	37	22	29.5	−.1	56	20	1	15	1,103	21	70	3.37	+2.0	1.06	10	1	8.3	5	12.2	nw.	34	ne.	30	4	6	21	7.6	38
La Crosse [2]	672	5	29	991.2	1,016.8	+.9	39	24	31.6	+1.8	59	24	4	1	1,038	24	73	3.21	+1.6	1.08	8	1	.7	1	10.9	nw.	43	sw.	25	3	7	21	7.6	45
Madison [2]	974	27	39	984.4	1,017.0	+.4	41	24	32.8	+2.2	64	28	5	1	1,001	23	70	2.35	+.3	.91	8	3	1.8	T	14.3	nw.	43	sw.	25	3	12	16	7.1	47
Charles City	1,015	10	51	976.3	1,014.2	−2.4	39	25	31.8	+1.1	60	24	5	1	1,031	...	...	2.45	+.7	.67	8	1	1.6	T	7.8	nw.	28	sw.	24	5	8	18	7.1	39
Moline [2]	606	6	50	994.9	1,017.6	+1.0	46	28	37.1	+2.3	70	29	11	1	868	27	68	2.76	+.4	.94	9	3	.9	0	12.0	w.	42	s.	24	7	7	17	6.7	48
Des Moines [4]	860	5	99	981.4	1,017.2	+.9	44	28	36.2	+.3	69	24	11	15	892	28	77	2.53	+.8	.91	7	1	.5	0	11.1	n.	42	s.	24	4	5	22	8.0	33
Dubuque	699	60	79	990.9	1,016.9	+.3	43	27	35.2	+1.2	66	24	8	15	921	25	71	2.25	+.2	.86	9	1	.5	0	6.8	nw.	21	se.	24	5	8	18	7.2	46
Burlington [2]	702	4	36	990.9	1,017.4	+.5	48	28	37.6	−.3	76	29	8	1	851	29	74	2.93	+.2	.91	9	1	.8	0	11.6	sse.	38	w.	27	6	7	18	6.7	49
Cairo	357	5	99	1,004.7	.....	.....	57	40	48.4	+.7	76	24	24	15	518	...	...	7.00	+3.2	3.36	15	3	4.0	0	10.2	ne.	34	n.	9	8	6	17	6.6	62
Peoria [2]	609	7	26	995.3	1,017.5	+.9	49	30	39.0	+.7	74	29	12	1	805	28	68	2.57	−.2	.94	7	2	.1	0	13.4	s.	45	sw.	27	9	4	18	6.7	62
Springfield, Ill. [4]	636	5	191	994.6	1,017.5	+1.2	50	31	40.6	+2.4	72	29	15	1	755	31	72	2.01	−1.2	1.05	10	2	1.6	0	14.4	s.	45	sw.	27	6	7	18	7.1	58
St. Louis [4]	568	33	59	996.3	1,017.4	+.5	53	35	44.4	+.3	75	24	15	15	645	34	70	2.54	−.8	.59	12	4	11.5	0	12.5	s.	34	n.	9	5	15	11	6.4	48
MISSOURI VALLEY																																			
									37.7	.0							75	2.07	+.2															7.4	
Columbia, Mo. [4]	784	6	66	987.8	1,017.4	+.8	52	33	42.8	−.1	77	29	12	15	688	32	72	2.03	−.9	.53	11	2	8.5	0	8.6	s.	26	s.	24	5	10	16	7.0	46
Kansas City [2]	963	38	76	988.8	1,016.8	+.5	52	34	42.9	+.2	78	29	11	15	684	31	67	2.92	+.6	.90	10	2	4.0	0	10.0	s.	42	sw.	24	4	11	16	7.4	46
St. Joseph [2]	967	5	51	986.1	1,016.5	+.2	51	30	40.6	+.1	76	28	9	15	758	31	71	2.82	+.3	1.31	9	2	2.4	0	12.8	s.	43	sw.	24	2	12	17	7.5	45
Springfield, Mo. [2]	1,324	5	50	970.5	1,017.0	+.7	54	34	43.8	+.2	75	5	14	15	657	35	73	2.58	−.8	.94	10	5	5.8	0	13.2	sse.	35	nw.	9	6	6	19	7.1	49
Topeka [4]	987	65	87	983.7	1,016.6	+.7	52	33	42.4	−.2	75	28	7	15	698	33	73	2.37	+.3	1.05	9	2	2.6	0	10.1	s.	34	sw.	24	4	9	18	7.1	43
Lincoln [4]	1,189	6	81	972.2	1,016.7	+.4	46	29	37.3	−.2	73	28	1	15	800	30	80	1.38	+.1	.47	10	0	3.2	0	10.6	n.	38	s.	24	3	7	21	8.0	40
Norfolk, Nebr. [2]	1,551	5	38	959.7	1,017.0	.....	40	25	32.2	−3.2	61	24	−3	15	1,017	27	81	2.93	+1.6	1.07	11	2	3.1	T	.....	n.	.....	.....	...	5	7	19	7.5	...
Omaha [2]	1,105	5	68	980.4	1,016.9	+.3	45	29	36.6	+.5	69	20	6	15	882	28	75	1.40	.0	.58	11	1	1.5	0	13.2	n.	52	sw.	24	2	9	20	7.7	39
Valentine	2,598	46	54	922.5	1,016.6	.0	43	22	32.6	+.3	73	20	−14	15	1,001	24	72	1.59	+.6	.43	8	1	14.1	2	8.7	n.	29	s.	23	7	8	16	6.5	61
Sioux City [2]	1,138	5	40	976.0	1,017.2	+.6	40	26	33.2	+1.1	66	24	1	15	984	28	82	1.70	+.6	.60	9	1	3.0	0	11.5	nw.	43	e.	30	4	5	22	7.8	39
Huron [2]	1,301	5	41	969.5	1,017.8	+.5	40	22	30.6	+1.7	56	4	−2	15	1,065	24	79	1.05	+.1	.53	8	1	5.1	0	11.5	n.	37	n.	30	5	6	20	7.5	39

See footnote at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR MARCH 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Temperature of the air: Averages: Mean minimum	Temperature of the air: Averages: Mean	Temperature of the air: Averages: Departure from normal	Temperature of the air: Extremes: Highest	Temperature of the air: Extremes: Date	Temperature of the air: Extremes: Lowest	Temperature of the air: Extremes: Date	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [6]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Precipitation: Days with 0.01 inch or more	Precipitation: Days with thunderstorms	Precipitation: Total snowfall (unmelted)	Precipitation: Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Wind: Speed of fastest mile: Miles per hour	Wind: Speed of fastest mile: Direction	Wind: Speed of fastest mile: Date	Character of day (sunrise to sunset), number of days: Clear	Character of day (sunrise to sunset), number of days: Partly cloudy	Character of day (sunrise to sunset), number of days: Cloudy	Sky cover, [7] tenths (sunrise to sunset)	Possible sunshine
	Ft.	*Ft.*	*Ft.*	*Mbs.*	*Mbs.*	*Mbs.*	°*F.*	°*F.*	°*F.*	°*F.*	° *F.*		° *F.*			°*F.*	%	*In.*	*In.*	*In.*			*In.*	*In.*	*m. p. h.*					*0-3*	*4-7*	*8-10*	*0-10*	%
NORTHERN SLOPE									30.3	−1.1							70	1.17	+.4														6.6	
Billings [2]	3,570	16	39	889.3	1,016.6	−1.0	42	22	32.0	−2.0	58	6	−1	14	1,028	21	68	.92	.....	.35	9	0	7.6	0	9.8	sw.	49	w.	27	8	6	17	6.5	58
Butte	5,533	44	58	826.3	1,019.4	.....	37	8	22.8	−5.5	50	19	−8	10	1,308	16	74	.64	.0	.15	10	0	13.1	6	6.5	s.	...	.....	...	7	4	20	7.0	...
Glasgow	2,086	34	53	940.7	1,018.2	.....	41	16	28.6	+3.0	60	31	−10	14	1,125	19	72	.20	−.6	.07	7	0	2.2	0	...	.....	...	.....	...	8	11	12	6.1	...
Great Falls [2]	3,657	16	75	886.9	1,016.7	.....	41	22	31.2	−3.1	58	19	−4	14	1,050	19	65	1.11	+.2	.28	10	0	13.8	0	12.2	sw.	54	sw.	27	7	9	15	6.4	69
Havre	2,507	11	67	926.2	1,018.0	+1.4	40	18	28.9	+1.8	60	6	−11	14	1,119	...	...	.41	−.1	.18	7	0	5.1	0	7.2	w.	27	nw.	27	10	6	15	6.0	62
Helena [2]	4,124	5	43	872.0	1,018.5	+3.3	40	18	28.8	−2.9	55	6	−3	10	1,124	19	69	.69	−.1	.25	8	0	12.1	0	7.6	w.	44	nw.	27	6	10	15	6.4	69
Missoula [2]	3,263	4	32	900.4	1,017.4	+.1	42	21	31.7	−1.8	51	31	7	17	1,031	23	74	.51	−.3	.23	11	0	8.1	0	5.1	nw.	26	se.	16	7	5	19	6.9	30
Kalispell	2,973	48	56	910.6	1,016.6	+.7	40	22	31.0	−1.9	49	21	1	14	1,056	...	...	1.30	+.4	.55	15	0	18.0	T	5.3	w.	19	n.	13	8	4	19	6.9	44
Miles City [2]	2,371	5	28	931.6	1,018.6	+1.0	37	15	26.2	.....	51	22	−15	10	1,204	20	...	.51	.....	.16	8	0	5.6	0	8.2	wnw.	...	.....	...	10	4	17	6.5	...
Rapid City [2]	3,259	5	56	901.5	1,017.2	−.1	41	20	30.7	−.9	57	22	−6	10	1,062	22	74	.25	−.7	.08	7	0	2.9	0	13.5	nnw.	43	nw.	24	8	8	15	6.3	70
Cheyenne [2]	6,094	22	40	806.6	1,014.6	−.6	43	21	32.2	−.9	60	19	6	31	1,020	21	67	2.44	+1.4	1.06	11	0	20.2	2	13.0	wnw.	45	w.	27	9	6	16	6.9	56
Lander [2]	5,352	6	30	824.9	1,014.9	−.7	44	22	33.0	+.6	62	19	11	14	985	22	66	1.88	+.7	1.26	8	0	20.2	1	6.1	sw.	28	w.	27	6	11	14	6.3	64
Sheridan [2]	3,790	5	38	876.4	1,016.9	+.3	43	20	31.4	.0	57	4	−4	10	1,041	21	69	1.15	.0	.39	10	0	13.8	0	7.2	nw.	43	nw.	27	9	7	15	6.1	57
North Platte [2]	2,821	11	51	915.7	1,015.8	−.5	46	25	35.4	−1.2	72	20	−7	15	922	27	75	4.37	+3.5	1.47	9	2	19.9	14	12.3	n.	65	n.	30	5	8	18	7.4	43
MIDDLE SLOPE									43.7	−.3							68	1.53	.0														6.7	
Denver [4]	5,292	106	113	832.4	1,013.0	−1.2	51	30	40.3	+1.0	73	19	16	14	765	21	58	2.41	+1.4	.61	10	1	15.4	4	7.4	s.	31	n.	26	3	11	17	7.1	60
Pueblo [2]	4,690	5	36	849.0	1,013.1	−.4	59	26	42.6	+1.8	77	16	16	15	692	24	56	.79	+.2	.37	7	1	7.8	0	7.3	w.	45	sw.	23	6	10	15	6.2	64
Concordia	1,392	50	58	966.5	1,017.3	+1.0	47	31	39.0	−2.0	73	28	6	15	808	32	78	1.03	−.2	.50	11	2	2.9	0	9.9	s.	32	sw.	24	8	4	19	7.1	41
Dodge City [2]	2,509	5	58	923.1	1,014.7	−1.2	53	30	41.8	−1.0	76	23	14	15	722	32	76	1.55	+.7	.60	8	1	.4	0	18.7	s.	49	sw.	7	6	9	16	6.5	48
Wichita [2]	1,358	52	64	964.8	1,015.6	+.4	54	34	43.7	−1.4	74	28	12	15	661	34	70	2.01	+.3	.81	8	3	.8	0	17.5	s.	49	s.	28	6	7	18	7.0	50
Oklahoma City [4]	1,214	10	47	968.2	1,015.8	+.2	61	39	50.0	.0	76	28	25	18	467	38	70	1.43	−.6	.66	7	2	T	0	11.0	s.	28	s.	23	12	4	15	5.8	60
Tulsa [2]	674	10	60	991.2	1,016.2	.....	60	38	48.8	−.6	77	24	24	15	509	38	70	1.50	−1.5	.56	9	2	1.3	0	13.6	s.	37	w.	30	5	8	18	7.0	54
SOUTHERN SLOPE									54.6	+.3							59	.64	−.4														5.9	
Abilene [2]	1,755	4	59	952.3	1,014.1	−.8	68	44	55.6	+.4	80	12	30	18	298	41	63	1.12	−.2	.65	3	2	T	0	15.2	s.	56	s.	20	4	6	21	7.2	63
Amarillo [2]	3,604	5	42	888.6	1,013.3	−1.3	61	33	46.7	+1.4	79	16	18	15	567	32	65	.57	−.1	.41	4	2	T	0	16.1	s.	61	sw.	29	10	9	12	5.6	66
Del Rio	960	63	71	979.7	1,013.6	−1.0	73	54	63.7	+.2	84	17	42	1	96	49	64	.35	−.4	.29	5	2	.0	0	9.8	se.	29	nw.	9	8	7	16	6.3	52
Roswell	3,614	6	29	888.6	1,011.8	−1.7	71	36	53.4	+2.1	81	28	27	2	358	25	39	T	−.7	T	0	0	T	0	10.2	s.	65	w.	20	14	8	9	4.3	74
Wichita Falls	1,030	4	49	977.7	1,015.1	.....	65	42	53.6	−2.4	80	23	27	18	357	40	65	1.16	−.7	.60	5	3	T	0	16.5	s.	...	.....	...	9	6	16	6.2	...
SOUTHERN PLATEAU									53.6	+.5							39	.34	−.5														5.0	
El Paso [2]	3,916	35	85	872.7	1,011.0	−1.9	71	43	57.0	+2.1	82	19	31	1	257	24	30	.04	−.3	.02	2	1	T	0	11.5	sw.	61	sw.	25	13	5	13	5.2	85
Albuquerque [2]	5,314	5	45	834.1	1,011.1	−2.1	62	34	47.9	+2.0	74	19	23	1	530	22	40	.65	+.2	.53	4	1	3.0	0	9.3	nnw.	56	se.	31	11	11	9	5.2	77
Flagstaff	6,907	34	48	786.7	1,015.1	+2.2	50	21	35.4	−1.1	63	19	3	1	915	19	54	.75	−1.4	.28	8	0	6.9	1	6.5	nnw.	...	.....	...	4	17	10	6.4	...
Phoenix [4]	1,107	39	87	973.6	1,013.0	−.5	74	47	60.4	−.3	85	18	39	30	148	31	39	.38	−.3	.27	3	0	.0	0	7.0	e.	32	nw.	25	14	8	9	4.2	88
Tucson [2]	2,555	5	39	924.1	1,012.7	+.2	73	42	57.6	−.1	87	19	31	9	230	25	32	.19	−.6	.18	2	1	.1	0	8.4	se.	34	sw.	31	11	10	10	5.4	88
Yuma	142	9	54	1,008.1	1,013.4	−.8	77	49	63.2	.....	87	15	42	24	84	35	...	.04	.....	.04	2	0	.0	0	8.2	wnw.	56	nw.	28	17	8	6	3.8	96
MIDDLE PLATEAU									39.3	+.1							63	1.38	+.3														8.1	
Ely [2]	6,262	8	41	804.9	.....	.....	43	21	31.8	−.7	57	19	7	6	1,030	...	...	.53	−.7	.23	8	2	5.5	0	12.5	s.	40	se.	19	0	10	21	8.4	55
Reno [2]	4,527	20	52	862.9	1,014.0	−2.6	53	27	40.2	+.2	66	15	16	29	767	25	59	.74	−.1	.29	8	0	2.7	0	8.7	s.	61	s.	19	1	10	20	8.0	44
Winnemucca	4,339	5	56	864.9	.....	.....	50	29	39.5	−.5	66	18	15	29	793	...	...	.91	.0	.22	11	1	3.0	0	8.1	sw.	27	sw.	19	2	4	25	8.4	35
Salt Lake City [2]	4,357	32	58	867.9	1,013.2	−3.1	52	33	42.4	+2.4	71	19	25	28	702	31	67	2.95	+1.2	1.06	12	2	2.3	0	9.1	sse.	49	nw.	16	1	7	23	8.4	52
Grand Junction [2]	4,602	5	26	849.0	1,013.9	+.4	53	33	42.8	−.8	71	19	29	2	687	29	63	1.75	+1.0	.78	11	0	11.0	0	6.1	esc.	33	s.	11	2	10	19	7.5	51
NORTHERN PLATEAU									40.6	−.1							70	1.08	.0														7.1	
Baker [4]	3,471	36	54	893.3	1,015.5	−2.5	48	30	39.2	+1.6	56	16	18	28	799	29	...	.51	−.6	.12	12	0	T	0	5.9	se.	21	n.	23	6	8	17	7.2	35
Meacham	4,056	7	28	873.7	1,015.9	.....	41	28	34.8	.....	52	4	16	28	936	29	81	1.25	.....	.18	15	0	7.9	25	6.2	se.	...	.....	...	2	7	22	8.1	...
Boise [2]	2,739	5	49	917.4	1,014.4	−3.6	53	33	43.2	+1.8	63	19	20	28	681	30	63	.48	−.9	.22	7	0	.0	0	10.3	se.	30	nw.	23	5	6	20	7.3	54
Lewiston	1,436	4	23	961.7	1,014.2	.....	53	35	44.0	.....	62	18	26	28	649	34	71	.93	.....	.22	12	0	.4	0	6.2	e.	...	.....	...	6	7	18	7.1	...
Pocatello [2]	4,478	5	31	860.1	1,015.0	−1.6	48	29	38.8	+2.9	62	19	21	30	815	26	64	1.10	−.2	.57	12	0	3.8	0	10.5	sw.	38	w.	27	4	9	18	7.2	52
Ellensburg [2]	1,735	5	58	952.6	1,016.3	.....	48	29	38.7	−2.2	59	31	16	1	815	30	75	1.16	+.6	.46	10	0	4.0	0	9.2	nw.	...	.....	...	7	6	18	6.8	...
Spokane [2]	1,929	6	51	945.8	1,015.7	−.9	47	29	38.0	−1.7	56	4	21	9	836	28	71	2.17	+1.0	.42	14	1	4.0	0	7.0	sw.	33	sw.	26	6	8	17	6.9	51
Walla Walla	991	57	65	980.0	1,015.9	−1.4	53	37	44.7	−1.4	67	18	26	1	631	36	...	1.03	−.6	.28	15	0	T	0	5.2	s.	25	w.	25	7	9	15	6.5	55
Yakima [2]	1,076	4	54	976.0	1,015.8	−.8	55	33	43.7	−0.1	65	4	26	15	658	31	65	1.06	+.8	.40	11	0	1.0	0	8.2	wnw.	...	.....	...	7	3	21	6.9	...
NORTH PACIFIC COAST									45.9	+1.4							77	3.24	−.5														8.2	
Kelso [2]	750	38	76	.....	.....	.....	55	36	45.4	.....	66	4	27	31	609	39	81	3.31	.....	.66	19	1	T	0	5.7	sse.	...	.....	...	1	10	20	8.5	...
North Head	211	5	55	1,007.1	1,014.9	−3.1	51	42	46.4	+1.2	59	11	35	28	579	...	...	5.29	−.3	.94	19	0	T	0	14.0	e.	52	s.	20	3	7	21	8.2	41
Seattle [4]	125	90	321	1,010.8	1,015.6	−1.7	54	41	47.5	+1.1	62	18	34	28	543	39	77	2.86	−.2	1.04	12	0	.0	0	8.7	s.	42	sw.	26	2	8	21	8.0	37
Tacoma	194	172	201	1,008.1	1,015.2	−2.1	52	40	46.3	+2.1	61	18	31	28	582	...	...	3.29	−.2	.87	17	0	T	0	7.6	n.	35	s.	26	6	9	16	7.1	44
Tatoosh Island	86	5	61	1,011.9	1,014.7	−1.6	49	41	44.7	+1.8	56	18	37	28	627	38	81	6.44	−1.4	1.05	21	0	T	0	16.0	e.	49	s.	26	6	2	23	7.7	38
Burns	4,162	35	47	870.3	1,014.6	.....	48	28	38.0	+1.7	57	18	19	28	835	28	70	.77	−.2	.18	15	0	2.4	0	...	.....	...	.....	...	0	8	23	8.3	...
Eugene [2]	433	4	35	1,001.7	1,014.2	.....	55	39	46.8	.....	64	16	32	28	561	42	86	3.52	.....	.47	22	0	.0	0	6.7	s.	...	.....	...	1	6	24	8.0	...
Medford [2]	1,329	29	58	967.2	1,015.3	−2.7	57	38	47.4	+0.5	64	12	26	31	542	35	68	1.08	−.4	.34	13	0	T	0	7.5	n.	...	.....	...	2	8	21	8.3	...
Portland, Oreg. [4]	154	68	106	1,009.8	1,015.9	−2.4	54	42	48.0	+1.1	64	4	36	24	526	39	80	3.33	−.6	.60	21	0	.0	0	5.9	se.	25	e.	10	2	5	24	8.3	31
Roseburg	510	45	76	997.0	1,015.8	−3.2	56	41	48.5	+1.4	68	18	34	31	512	40	72	2.49	−.8	.63	24	1	.0	0	3.9	s.	20	s.	19	0	7	24	8.5	27

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR MARCH 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Temperature of the air: Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [6]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover [7] tenths (sunrise to sunset)	Possible sunshine
MIDDLE PACIFIC COAST	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m. p. h.					0–3	4–7	8–10	0–10	%
Eureka	60	72	88	1,013.9	------	------	55	44	49.8	+1.5	65	13	36	31	468	---	--	6.32	+2.8						8.9	se.	35	ne.	30	3	4	24	7.4 8.0	48
Red Bluff [2]	353	5	26	1,003.1	1,016.1	------	58	44	51.3	−2.3	72	29	38	11	423	40	72	6.94	+1.7	2.34	23	0	.0	0	9.2	se.	34	se.	15	5	2	24	7.8	43
Sacramento [4]	66	92	115	1,015.2	1,016.3	−1.3	61	46	53.3	−1.0	69	31	40	8	362	43	75	8.33	+5.1	1.66	19	3	.0	0	8.1	se.	30	n.	28	4	9	18	7.1	51
San Francisco [4]	155	112	132	1,015.9	1,016.6	−1.4	58	48	53.2	−1.0	65	29	45	24	366	44	76	4.15	+1.6	.82	11	2	.0	0	10.4	w.	36	w.	27	5	8	18	6.8	50
SOUTH PACIFIC COAST																		5.85	+2.7	1.31	12	0	T	0										
Fresno [2]	327	5	34	1,006.4	1,016.9	−1.1	65	44	55.5	−.8	77	18	38	31	327	43	72	1.92	−.1						5.5	nw.	31	nw.	30	3	12	16	5.9 7.2	60
Los Angeles	338	236	263	------	------	------	66	47	54.4	.0	72	15	43	12	279	---	71	3.60	+2.0	.90	13	1	.0	0	7.1	w.	38	w.	22	9	12	10	5.5	78
San Diego [2]	87	20	55	1,015.6	1,017.2	+.6	64	48	56.0	−1.5	70	15	44	9	272	47	73	1.40	−1.4	.70	8	0	.0	0	7.0	wnw.	30	w.	28	7	18	6	5.1	77
WEST INDIES									56.2	−.8								.75	−1.0	.32	8	1	.0	0										
San Juan, P. R.	82	9	54	1,012.5	1,019.0	------	80	70	75.0	−.4	85	17	67	10	0	----	--	3.20	.0	1.02	17	0	.0	0	11.2	e.	38	e.	25	5	20	6	5.9	59
ALASKA																																		
Anchorage [2]	132	6	44	1,003.1	1,008.1	------	39	20	29.4	+5.7	50	7	7	15	1,101	24	74	1.05	+.5	.65	5	0	12.9	17	5.0	nw.	27	s.	22	8	4	19	6.9	--
Annette Island	113	5	53	1,009.5	1,013.5	------	45	34	39.6	+.3	54	10	28	28	785	32	74	7.79	−.7	2.52	15	0	1.9	0	10.8	nw.	--	------	--	8	1	22	7.1	--
Barrow	29	5	27	1,014.2	1,014.9	------	2	−14	−5.6	+9.0	30	9	−33	2	2,189	14	70	.02	−.1	.01	2	0	.2	15	10.0	nne.	35	e.	3	9	13	9	5.4	--
Bethel [2]	28	5	31	1,003.1	1,003.7	------	27	11	19.0	+7.7	40	7	−16	25	1,429	16	82	2.71	+1.8	1.21	12	0	23.1	21	12.0	e.	--	------	--	9	8	14	5.7	--
Cordova [2]	45	5	32	1,007.5	1,009.1	------	39	25	31.7	+1.5	43	8	11	17	1,034	28	87	9.58	+4.1	3.56	18	0	24.3	19	5.4	ese.	30	ese.	23	6	4	21	7.0	--
Fairbanks [2]	455	5	63	991.5	1,009.1	------	34	6	20.0	+10.4	50	9	−11	28	1,395	18	79	.38	−.3	.13	9	0	5.4	15	----	e.	22	sw.	24	10	5	16	6.0	--
Galena	139	4	66	1,003.4	1,008.1	------	26	6	16.4	+12.0	40	9	−20	30	1,503	11	69	.80	.0	.18	13	0	7.9	26	----	n.	30	e.	2	11	5	15	5.8	--
Gambell	32	5	32	1,003.4	1,004.4	------	17	9	12.8	+6.8	34	10	−10	25	1,618	10	87	.71	−.1	----	13	0	7.0	24	23.0	nne.	56	se.	12	6	5	20	8.0	--
Juneau [2]	80	6	30	1,012.5	1,013.5	------	42	28	35.2	+2.4	49	26	18	10	925	28	75	2.09	−1.0	.68	16	0	1.7	0	----	ese.	34	se.	24	9	2	20	6.5	--
Kotzebue [2]	20	5	31	1,008.1	1,008.8	------	19	4	11.2	+12.4	34	10	−26	28	1,665	9	84	.56	+.3	.12	10	0	5.7	20	----	ese.	--	------	--	8	4	19	6.8	--
McGrath [2]	341	5	31	994.6	1,007.8	------	30	6	17.7	+10.3	46	9	−23	27	1,467	12	66	1.33	+.2	.51	15	0	13.6	34	----	nnw.	29	sse.	21	6	7	18	6.9	--
Nome [2]	22	10	75	1,013.9	1,014.6	------	24	11	17.9	+9.2	36	7	−22	29	1,463	15	87	1.41	+.6	.31	14	0	13.8	74	17.0	e.	50	e.	9	7	4	20	6.7	--
Northway [2]	1,718	5	32	946.8	1,011.9	------	30	−7	11.6	+3.5	43	22	−25	17	1,667	6	66	T	−.3	T	0	0	T	8	2.5	nw.	--	------	--	10	7	14	5.8	--
HAWAII																																		
Honolulu [4]	38	86	98	1,017.6	------	------	76	67	71.7	+.3	79	20	64	15	0	----	--	.67	−2.5	.14	14	1	.0	0	10.6	ne.	31	ne.	13	14	14	3	4.4	74

[1] Height of barometer cistern above mean sea level on Jan. 1, 1900, or when station was first established since Jan. 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevations, according to note 1.

[3] Barometric, hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records, remainder from city office records.

[5] Barometric, temperature, degree day, and hygrometric data from airport, remainder from city office records.

[6] As of Jan. 1, 1949, relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after Jan. 1, 1949, cannot accurately be combined without necessary conversion.

[7] As of Jan. 1, 1949, "Sky cover" has been substituted for "Average cloudiness" to include smoke, snow, etc., in addition to clouds that obscure the sky.

NOTE.—Unless otherwise indicated, data in table are city office records.

SEVERE STORMS FOR MARCH 1949

[The table hereunder contains such data as have been received concerning severe local storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Bakersfield, Calif.	4	3:07-4 p. m.				Thunderstorm	Caused flash floods. Reported to be one of the most severe thunderstorms on record in San Joaquin Valley. Some basements flooded, and minor damage reported to house foundations, landscapes, etc.
Do	7	3:58–5:55 a.m., 6:36–8 p. m.				do	Flooded streets and some first floors of store and office buildings, damaging house foundations, landscapes, etc.
On Green Bay east of Menominee, Mich.	7				$150,000	Ice breakup	Strong southerly winds caused sudden movement of ice field away from shore, endangering lives of about 100 commercial fishermen. All escaped to shore, but 3 trucks and considerable number of fishing nets lost.
Banks (2 miles north of), Ark.	9	10:30 a. m.	100	0	1,000	Tornado	1 house blown from foundation and roof blown off another.
Deridder, La.	9	11:30 a. m.	50	0	18,000	do	Moved northeastward; path short. 1 person injured; 15 homes and 1 building damaged.
Terry, Miss.	9	1:30 p. m.		1	10,000	Thundersquall	27 persons injured when schoolhouse destroyed.
White Haven (9 miles southeast of Memphis), Tenn.	9	4:36–4:50 p. m	35		10,000	Thunderstorm, hail and wind.	Storm associated with passage of cold front. 4 homes of poor construction completely demolished, small buildings destroyed, and trees uprooted. 5 people injured.
Columbus, Ga.	9	8–8:30 p. m.			10,000	Wind and electrical	Freak windstorm struck 2 separate points in northern part of Columbus. Wind speed 60 to 70 m. p. h., caused rather heavy damages with injuries to 1 person. Power and communication lines blown down. Some lightning damage; concessions in city park badly damaged. Fragment of signboard crashed through windshield of automobile badly lacerating face of rider. Similar storm struck Phoenix City, Ala., just across river from Columbus at same time.
Ohio, western and northern counties.	10	A. m.				Snow	Snow up to 7 inches in some localities; drifted badly, impeding traffic. Roads icy in spots. Rural schools closed. Some traffic accidents and injuries.
Dade City, Fla.	14	Midnight		0	8,000	Tornado	Destroyed barn and contents, twisted off pine trees, and carried portions of galvanized iron barn roofing distance of half mile. No injuries.
Howey-in-the-Hills, Lake County, Fla.	14	do		0	15,000	do	Uprooted over 500 citrus trees, mostly large grapefruit. Some grapefruit trees carried several hundred feet. 1 home partially unroofed and power lines broken. No injuries.
Wilson, N. C.	18	9:10 a. m.			12,000	Wind	Preceded passage of cold front.
Lake City, Fla.	18	1:22–1:25 p. m.		0		Tornado	Small twister moved 4 miles northeastward then eastward.
Jacksonville, Fla.	18	2:05–2:20 p. m.			800	Wind	Blew down 40-foot section of wooden shed, damaging 2 parked cars.
Hookerton, N. C.	18	4:15 p. m.		0		Tornado	A very small storm.
Miami, Fla.	20					Rain	24-hour rain of 7.07 inches flooded low ground areas at International Airport.
Rapides and LaSalle, Parishes, La.	21	Noon		0	55,000	Tornado	Moved northeastward; path about 20 miles long. 2 injuries; 1 home, and 11 buildings destroyed; 14 homes damaged.
Walthall and Lincoln Counties, Miss.	21	P. m.	50	0	10,000	do	1 person injured at Fair Oak Springs; 1 home and 2 other buildings destroyed. $5,000 damage to crops included in total.
Yazoo, Humphreys, and Holmes Counties, Miss.	21	P. m.	100	1	100,000	do	Moved northeastward. 19 persons injured. 6 homes and 15 other buildings destroyed, and 52 homes and 65 other buildings damaged; mostly tenant houses and barns.
Vermillion, S. Dak.	24	1:50 p. m.		0		do	Lasted 10 minutes; moved northward about a mile, striking 3 farms. 4 sheds, 2 barns, 3 windmills, and wagon boxes destroyed. Power lines snapped.
Lincoln, Nebr.	24	3 p. m.			2,600	Wind	38 m. p. h. fastest mile at city office. Damage to copper sheet roof of capitol $2,000, and to plate glass windows $600.
Iowa, northern portion	24	Afternoon				Wind, rain, and hail	Extensive damage in several local communities. Struck 2 farms at Grafton, 15 miles northeast of Mason City, destroying large barn, several smaller buildings, and killed some livestock. At Woolstock, north of Webster City, 1 house unroofed, plate glass windows in stores broken, and many utility wires downed.
Oak Grove, La.	24	10 p. m.	100	0	63,000	Tornado	2 injured; 3 homes, 14 other buildings destroyed; 11 homes, 6 other buildings damaged. Storm developed near Oak Grove, La., and moved into Washington and Sunflower Counties, Miss.
Washington and Sunflower Counties, Miss.	24	11–11:30 p. m.	100	7	295,000	do	Moved into Washington County from Louisiana on a northeastward track of 90 miles in both States. 67 persons injured in Mississippi; 43 homes destroyed and 54 others damaged; 38 other buildings destroyed and 50 damaged; mostly small tenant houses and barns.
Maryville and vicinity, Nodaway County, Mo.	24					Wind	Exceeded 50 m. p. h. at times. Damaged out-buildings and roofs of sheds. Scattered corn cribs. Broke a number of tree limbs and uprooted a few old trees.
Benjamin, Knox County, Tex.	25	7:10 a. m.	11	0	35,000	Tornado	Plate glass store windows broken. Business house roofs damaged. Lumber yard demolished. Telephone system damaged. Light hail.
Dallas, Tex.	25	8:58 a. m.			30,000	Wind	9 shops in Oak Cliff, Cedar Crest, and Skyline sections wrecked; plate glass windows damaged. Light to moderate hail in some sections.
Desdemona, Eastland County, Tex.	25	12:25 p. m.	800	0	31,000	Tornado	Entire northwest section of town destroyed. 14 homes completely destroyed; 8 cars damaged.
Tippah County, Miss.	25	8 p. m.		0	25,000	do	1 home and 3 other buildings destroyed; 5 homes and 14 other buildings damaged. 1 person injured.
Itawamba County, Miss.	25	8 p. m.		0	52,000	do	3 homes and 11 other buildings destroyed; 8 homes and 20 other buildings damaged.
De Leon, Comanche County, Tex.	25	11:55 p. m.		0	200,000	do	A 60-foot steel tower crumbled. Windows in electric main plant shattered, and roof torn from office building.
Martinsburg, Mo.	26	1–2 a. m.			500	Electrical	Lightning damaged house; also knocked out 11 lines at telephone switchboards.
Fort Worth, Tex.	26	1:10 a. m.			20,000	Wind	Buildings unroofed. Hangars blown down, and airplanes damaged. Electric and telephone wires broken.
Jay, Parker County, Tex.	26	1:30 a. m.	83	0	10,000	Tornado	Damage to buildings and equipment.
Springtown, Parker County, Tex.	26	1:30 a. m.	880	0	100,000	do	Destruction ranged from total to light damage. Wrecked 15 homes and 2 stores. At least 6 persons injured. Hail size of small marbles, caused no damage.
Southmayd, Grayson County, Tex.	26	2 a. m.			18,000	Wind	Small buildings damaged. Several windmills blown down. Porches ripped from several homes. Crop damage, $3,000 included in total.
Pittsburg and Adair Counties, Okla.	26	3:55–5:40 a. m.	(1)	2	230,000	Tornado	Moved northeastward from Ward Spring to Haywood, to Shady Grove, through Crowder to 5 miles northeast in Pittsburg County, with skipping effect over a path approximately 20 miles long, then apparently skipped 88 miles northeastward to Westville in Adair County. Probably a single tornado as timing and direction in line with a forward progress of 50 m. p. h. 25 persons injured at Crowder, where 13 business houses and 50 houses destroyed. Several buildings damaged at Haywood. Damage $180,000 in Pittsburg County, $50,000 in Adair County.
Tontitown (near), Ark.	26	6 a. m.	16	0	2,500	do	Apparently same tornado that struck Westville, Okla. Struck 12 miles west of Springdale. Destroyed a house, garage, and 2 chicken houses

See footnotes at end of table.

SEVERE STORMS FOR MARCH 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Seymour, Baylor County, Tex.	26	6 a. m.			2,000	Wind	Unroofed 1 lumber yard and 3 small barns. Light hail.
El Paso, Tex.	26	Afternoon			500	do	Small damage to roofs. A little small hail.
Clark to Poinsett Counties, Ark.	26	2:30–4:30 p. m.	[1] ¼ to 2	19		Tornado, accompanied by torrential rains and hail.	Storm moved northeastward. First struck Whelen Springs, where 1 person killed and 7 injured; 13 houses, 5 barns and a church destroyed. Great timber loss near Dalark. In England, Scott, and Keo communities of Lonoke and Pulaski Counties 13 persons killed and 49 injured. 30 houses demolished and 30 others damaged. Cars and trucks blown from highway. Furniture torn to bits and scattered for miles. Damage in these communities about $500,000. At Hensley, Pulaski County, high wind, hail and heavy rain; Lassiter school leveled. At Lonoke, Lonoke County, 1 woman killed by lightning. At Hazen, Prairie County, several persons injured. Houses completely destroyed. Barns and outbuildings demolished; machinery and brooders destroyed. Livestock killed. $100,000 damage this area. In Howell-Wiville Community, near McCrory, Woodruff County, 1 person killed and several injured. At Tipp, south of McCrory, several persons killed and 4 injured; 10 homes destroyed. At Beedeville, Jackson County, 13 persons injured; houses destroyed. At Augusta, Woodruff County, 1 person killed and several injured; houses destroyed. Harrisburg, Poinsett County, railroad station damaged. Telephone lines down; rice mill heavily damaged; city jail unroofed. In the 10 counties hit, 57 persons hospitalized and 95 more injured; 186 buildings demolished or damaged, 204 families affected; 111 homes destroyed, 90 damaged.
Bollinger County, Mo.	26	4:30–4:45 p. m.	150	0	1,000	Tornado	7 persons injured, 2 seriously. Killed some hogs. Damaged a few homes, barns, garages and outbuildings. Storm struck in thinly-settled community.
Pemiscot County, Mo.	26	5:40–6:15 p. m.				Winds, lightning and hail.	3 small farm homes demolished by wind, a few miles west of Caruthersville, injuring several people. Another home blown off its foundation, and 13 transmission line poles felled. Near Hayti, large barn blown down.
Webster, Calhoun, Pontotoc, Lee and Prentiss Counties, Miss.	26	6:45–8:45 p. m.	200	2	627,000	Tornado	Developed in Webster County and moved northeastward to near Booneville, Prentiss County, over path 90 miles long, passing near Tupelo. Greatest damage at Belden and Chesterville. A new $60,000 school and a church destroyed. 33 persons injured; 33 homes and 116 other buildings destroyed; 60 homes and 330 other buildings damaged.
Dexter and Hardin, Marshall and Calloway Counties, Ky.	26	7:45–7:47 p. m.	200	0	19,400	do	Path about 5½ miles long. 2 persons seriously injured by falling buildings. 4 houses, 10 barns, and 12 small outbuildings demolished; many others damaged. 300 poultry killed.
Calhoun, Ky.	26	9 p. m.			5,000	Wind	2 persons injured when grocery store and a restaurant damaged.
New Cypress (near Graham), Muhlenberg County, Ky.	26	9–9:05 p. m.	50	0	20,000	Tornado	Path 2 miles long. 2 persons seriously injured. 4 dwellings, 2 barns and many outbuildings demolished; 5 houses, 8 barns, and 2 automobiles damaged. Many chickens killed.
Troy, Tenn.	26	During night		0	100,000	Tornado and rain	Trees, and telephone and power wires blown down, disrupting service Bank of Troy, Salant Shirt Factory, a church, funeral home, telephone exchange, and stores damaged. Heavy rain added to damage. Nearly all of homes damaged; some destroyed. 2 persons injured.
Nebraska, southwestern and central portions.	29–30		[1] 130	4	300,000	Snow and gale	28 inches of snow fell at Hayes Center; 12 to 20 inches elsewhere in southwest, and ranging up to 10 to 15 inches in north-central localities. Heavy snow accumulating on wires, with subfreezing temperatures, caused much breakage of poles and wires, resulting in loss of power and communications. Damage of this character about $150,000. Much stalling of cars and interruption of travel. Livestock losses in small areas about $150,000. Young stock, such as lambs and calves suffered most. In the southwest and some extreme north-central areas, storm was a blizzard.
Dewey, Blaine, Major, Garfield, Grant, and Kay Counties, Okla.	30	12:38–3:20 a. m.	100–600	4	1,087,000	Tornado	Storm began 9 miles southwest of Canton, moved northeastward through Canton and Longdale, 16 miles northeast of Longdale, 3 miles north and northeast of Enid, near Hunter, through Grant County, through Blackwell, and crossed border to near Dexter, Kans.; a total of 130 miles. Rate of progress about 37 m. p. h. Considered a single tornado, with "skipping" effect, although possibility this was a series with clouds dissapating and re-forming as storm progressed. Three deaths in Canton, 1 in Longdale; 31 injured in Canton-Longdale area, 7 injured at Blackwell. Estimated damage: $750,000 or more at Canton-Longdale; $37,000 in Garfield County, of which $30,000 to aircraft at Enid Airport; $300,000 at Blackwell. Some light hail. Cloudbursts at Fairview and Meno in Major County. At Fairview, about 8 miles to the left of projected path, there was little wind; but 4.01 inches of rain fell, mostly in the 30 minutes from midnight to 12:30 a. m. Estimates of 8 to 10 inches of rain in less than an hour at Meno, 5 miles to the left of projected path.
Cowley County, Kans.	30	4:15 a. m.	1,200	0	10,000	do	All buildings demolished on a farm 2 miles south and 2 miles east of Dexter. Some livestock and many chickens killed. 2 persons injured. Path of destruction apparently less than a mile long. Evidently same tornado that moved from Canton to Blackwell, Okla.
Craig County, Okla.	30	7:30–8 a. m.		0	1,000	do	Small buildings demolished and house moved from foundation 12 miles west of Vinita.
Fulton and southwest Callaway County, Mo.	30	2:20 p. m.	[1] 1½		175,000	Hail and rain	Some basements in Fulton flooded, but great majority of damage by hail. Storm hit in strip from New Bloomfield through Guthrie and into Fulton. Greenhouses heaviest sufferers. Many homes reported broken window panes and damaged roofs. Cloth top autos hard hit.
Callaway County, Mo.	30	About 6 p. m.			1,000	Wind	Newspaper clipping reported storm as a "young tornado," but only damage was to a large feeding barn, on farm about 7 miles southwest of Martinsburg.
Jasper County, Miss.	30	8 p. m.			5,000	do	1 home destroyed and 3 damaged; 5 other buildings damaged.
Copiah County, Miss.	30	8 p. m.			8,000	do	2 homes destroyed and 3 damaged.
Chesterfield, Ill.	30	9:15 p. m.	440	0	35,000	Tornado	Origin near Kemper; moved northeastward to 1 mile west of Reeder. Heaviest damage to buildings on 5 farms, 2 miles west of Chesterfield. At Kemper roofs of 5 buildings damaged. No injuries reported. Light hail.
Washington County, Okla.	30	P. m.			1,000	Wind	Roofs of houses and other buildings damaged.
South Dakota, southeastern portion.	30–31				500,000	Snow and wind	Extremely wet snow clung to objects. Cross-arms to telephone poles broke, causing most of trouble. Power and communication lines failed; much loss of food in lockers.

See footnotes at end of table.

SEVERE STORMS FOR MARCH 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Minnesota, extreme south and east-central counties.	30–31	----------	---------	3	40,000	Glaze, sleet, snow, and wind.	Many poles and wires down. Communication and electric services seriously disrupted. Traffic of all kinds delayed. Much poultry perished. Snow and ice on wires and cables varied from ¼ to about 6 inches in diameter. Ice began to form on wires about 7 p. m. on 30th in extreme southwest and remained on wires in some localities until 5 p. m. of 31st. Heaviest snow and ice formation between Redwood Falls and New Ulm. Snow unusually moist and clung to wires, trees and shrubbery. About 247 poles down and about 801 wire breaks occurred. Loss to overhead wire systems about $39,100; to poultry, $900. Unusually heavy snowstorm in extreme southwest, with 18 inches falling at Tracy and 15 inches at Marshall. Very beneficial in replenishing soil moisture.
Niceville, Fla	31	9 a. m.	15-20	0	2,000	Tornado	Moved northeastward. 1 house destroyed, several others damaged; some trees uprooted, other twisted off. 1 injury.
Uniontown, Pa	31	6:15–6:40 p. m.	65	0	140,000	do	Moved eastward in path 6 miles long. Barn ripped apart and overturned; open air movie screen damaged; fruit orchards damaged and 1 destroyed. 2-car garage near Hopwood tossed into air. Uniontown Country Club building partially demolished. 5 homes partially wrecked. 3 persons injured.

[1] Miles instead of yards.
[2] 1,500 yards at Crowder, 300 yards at Westville.

DELAYED STORM REPORT FOR FEBRUARY 1949

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Waimea (vicinity of), Kauai, Hawaiian Islands.	7	----------	---------	------	$500,000	Flood	Heavy rains mountainward of Waimea caused Makaweli and Waimea streams to overflow, flooding town. Buildings, including many homes, moved from foundations and severely damaged; several collapsed.

SOLAR RADIATION DATA FOR MARCH 1949

Explanation of tables 1 and 2 and references to descriptions of instruments, stations, and methods of observation, and to summaries of data, are given in the MONTHLY WEATHER REVIEW, vol. 72, No. 1, January 1944, p. 43. A list of pyrheliometric stations is given on page 45 of that issue. An explanation of the formula used in computing the air mass values for each station listed in table 1 appears in vol. 75, No. 3, March 1947, p. 47.

In mid-March, Eppley 180° pyrheliometers and Brown integrating potentiometers were installed at the Weather Bureau Airport offices in Albany, N. Y., and Portland, Maine.

The coordinates of the Albany station are latitude 42° 45′ N.; longitude 75°48′ W.; and elevation 94 meters. There are no serious obstructions to the free horizon, although the airport beacon to the WSW will create momentary shading near sunset in early spring and late autumn. Located within the triangle formed by Troy, Albany, and Schenectady, industrial smoke from one or more of these cities may be expected to vitiate the record to some extent.

The coordinates of the Portland station are latitude 43°39′ N.; longitude 70°19′ W.; and elevation 10 meters. The horizon offers few obstructions to the instrument, except to the north where the glass-enclosed control tower shades an appreciable amount of radiation from the northern sky.

Starting with March 5, 1949, with the Albany record and March 24, 1949, with the Portland record, daily totals and weekly means of total solar and sky radiation received on a horizontal surface at these stations will appear regularly in table 2.

TABLE 1.—*Solar radiation intensities during March 1949*

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
MADISON, WIS.											
	Air mass										
	4.81	3.84	2.88	1.92	*0.96	1.92	2.88	3.84	4.81		
March	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1	0.79	0.96	1.10	1.14	------	1.25	------	------	------	0.8	1.6
4						1.21				6.1	6.4
7	.90	1.03	1.15	1.33	------					2.2	3.1
10	.92	1.08	1.16	1.35	------					1.7	2.2
11	.87	.99	1.15	1.31	------					1.9	1.9
12	.95	1.07	1.21	1.35	------					1.7	1.7
15	.90	1.02	1.14	1.33	------	1.31				.9	1.4
17	.91	1.03	1.18	1.34	------	1.16				1.4	1.8
19	.92	1.03	1.15	1.26	------					1.3	2.1
28	.71	.86	1.02	1.21	------					5.8	5.8
Means	.87	1.01	1.14	1.29	------	1.24	------	------	------	------	------
Departures	+.06	+.06	+.04	+.02	------	−.04	------	------	------	------	------

TABLE 1.—*Solar radiation intensities during March 1949*—Con.

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
BLUE HILL, MASS.											
	Air mass										
	4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
March	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
3					------	1.38	1.19	1.06	0.94	1.4	1.7
4	1.03	1.11	1.24	1.37	------					1.8	2.5
9	.90	.94		1.23	------	1.36	1.22	1.10	------	4.1	5.8
14	1.02	1.15	1.26	1.39	------	1.28	1.10	.95	.87	2.6	2.8
16	1.00	1.11	1.24	1.39	------	1.41	1.26	1.14	1.03	1.5	1.5
17	.38	.47			------	1.38	1.23	1.12	1.03	3.6	2.2
19	1.12	1.20	1.30	1.45	------		1.27	1.14	1.04	1.0	1.6
20	1.05	1.16	1.29	1.42	------	1.38	1.22	1.06	.94	0.9	1.4
24					------	1.09	.95	.73	.64	5.6	5.9
29	.78	.90	1.02	1.18	------					4.8	4.8
Means	.91	1.00	1.22	1.35	------	1.33	1.18	1.04	.93	------	------
Departures	+.03	+.03	+.13	+.11	------	+.09	+.13	+.10	+.10	------	------
LINCOLN, NEBR.											
	Air mass										
	4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
March	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
25	0.88	0.96	1.09	1.22	1.36	------	------	------	------	5.3	5.3
Means	.88	.96	1.09	1.22	1.36	------	------	------	------	------	------
Departures	+.06	+.03	+.01	−.05	−.14	------	------	------	------	------	------
TABLE MOUNTAIN, CALIF.											
	Air mass										
	3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
March	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
8				1.50	------	------	------	------	------	------	------
12	1.22	1.30	1.40	1.51	------	------	------	------	------	------	------
17	1.13	1.24	1.36	1.49	------	------	------	------	------	------	------
18				1.45	------	------	------	------	------	------	------
27	1.03	1.12	1.25	1.42	------	------	------	------	------	------	------
Means	1.13	1.22	1.34	1.47	------	------	------	------	------	------	------
Departures	.00	.00	+.01	+.01	------	------	------	------	------	------	------
BOSTON, MASS.											
	Air mass										
	4.96	3.96	2.97	1.98	*0.99	1.98	2.97	3.96	4.96		
March	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
4	0.81	0.93			------					1.9	2.7
9	.85	.90	1.01	1.32	------	1.39	1.24	------	------	3.6	6.1
14	90	.99	1.15	1.36	------	1.35				2.6	2.1
16	------	.91	1.15	1.40	------	1.34	1.27	1.15	------	1.5	1.5
17	------	------	------	1.42	------	1.32	1.19	------	------	3.5	2.1
Means	.85	.93	1.10	1.38	------	1.35	1.23	1.15	------	------	------
Departures	+.23	+.22	+.24	+.31	------	+.22	+.24	+.37	------	------	------

*Extrapolated

[1] 75th Meridian Time.

NOTE.—Figures in parenthesis are interpolated.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct+diffuse) received on a horizontal surface during March 1949*

[Gram-calories per square centimeter]

Date	Honolulu, T. H.	Pearl Harbor, T. H.	La Jolla, Calif.	Riverside, Calif.	Santa Maria, Calif.	Inyokern, Calif.	Oak Ridge, Tenn.	Nashville, Tenn.	Fresno, Calif.	Davis, Calif.	Washington, D. C.	Columbia, Mo.	Soda Springs, Calif.	Grand Lake, Colo.	New York, N. Y.	Salt Lake City, Utah	State College, Pa.	Lincoln, Nebr.	Newport, R. I.	Put-in-Bay, Ohio	East Wareham, Mass.	Blue Hill, Mass.	Boston, Mass.	Ithaca, N. Y.	Twin Falls, Idaho	Albany, N. Y.	East Lansing, Mich.	Madison, Wis.	Portland, Maine	Toronto, Canada	Summit, Mont.
1949	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Feb. 26	381	417	127	76	-----	331	353	425	110	124	351	351	321	485	426	248	382	147	246	295	108	64	92	71	400	----	295	280	-----	374	330
Feb. 27	610	503	220	215	-----	203	25	64	155	421	238	168	456	503	321	278	429	142	428	256	419	429	374	235	383	----	137	128	-----	287	(370)
Feb. 28	368	329	260	198	-----	465	420	447	262	222	207	488	(442)	333	35	267	147	420	44	137	64	66	61	13	298	----	259	415	-----	73	374
Mar. 1	428	281	396	431	-----	370	451	468	292	168	362	410	202	275	392	352	425	269	156	420	40	114	110	124	330	----	329	394	-----	383	(373)
Mar. 2	583	433	388	196	-----	363	397	413	194	176	399	415	121	516	452	321	352	282	457	156	450	458	405	265	246	----	60	92	-----	262	365
Mar. 3	633	545	380	334	-----	477	443	385	108	80	273	250	(75)	456	364	390	358	157	465	392	413	429	352	158	317	----	224	76	-----	407	302
Mar. 4	489	423	429	346	-----	271	440	445	400	274	378	431	543	515	310	410	189	397	465	194	443	457	339	133	373	----	118	339	-----	54	274
Means	499	419	316	257	-----	354	361	378	217	209	316	359	309	440	328	324	326	259	323	265	277	288	248	143	335	----	204	246	-----	263	345
Departures	−35	−37	−55	−85	-----	----	----	+106	−134	−96	+37	+81	+5	+26	+74	+28	+92	−42	+46	+40	+23	+7	+33	−66	+46	----	−11	−23	-----	+65	+32
Mar. 5	598	542	422	408	-----	528	429	441	445	224	310	448	332	344	302	208	278	399	283	286	261	351	285	144	169	297	166	280	-----	116	154
Mar. 6	623	566	381	391	-----	443	126	335	362	372	222	214	494	380	234	358	102	219	279	336	268	206	185	54	330	160	241	396	-----	221	96
Mar. 7	506	459	432	326	-----	496	494	479	214	379	494	361	240	429	462	183	502	219	249	481	199	176	162	313	239	394	396	380	-----	374	58
Mar. 8	594	584	485	512	-----	539	349	231	447	388	473	58	484	319	476	194	388	49	110	370	77	228	230	240	324	448	113	122	-----	175	282
Mar. 9	646	599	455	482	-----	456	54	53	132	93	264	21	153	413	404	326	204	358	467	47	191	480	456	153	268	490	55	338	-----	27	444
Mar. 10	659	600	485	504	-----	568	37	59	122	123	76	456	139	237	73	345	51	220	80	72	77	89	92	45	324	96	204	421	-----	32	467
Mar. 11	552	295	451	475	-----	293	503	466	266	102	393	288	150	423	97	308	242	195	41	444	113	36	48	51	173	161	279	394	-----	229	470
Means	597	521	444	442	-----	475	285	301	284	240	319	264	284	363	293	274	252	237	216	291	170	224	208	143	261	292	207	333	-----	168	281
Departures	+33	+23	+21	+18	-----	----	----	+17	−112	−106	+7	−37	−38	−31	+19	−38	−22	−84	−79	+6	−94	−65	−38	−97	−80	----	−43	+34	-----	−84	−9
Mar. 12	393	348	484	428	-----	547	488	326	504	318	386	198	390	258	-----	277	242	357	345	537	276	369	319	121	302	320	315	477	-----	371	235
Mar. 13	650	615	429	398	-----	480	147	194	446	425	508	509	457	374	-----	445	485	59	343	491	345	407	423	276	423	368	404	352	-----	447	165
Mar. 14	629	553	463	442	-----	499	207	311	514	244	463	199	358	274	441	421	375	196	518	236	493	526	484	249	373	518	270	338	-----	148	446
Mar. 15	492	474	309	345	-----	427	219	427	262	148	154	561	457	505	221	416	324	433	333	471	261	385	329	184	250	343	233	489	-----	415	123
Mar. 16	518	530	484	440	-----	574	549	497	556	383	490	107	194	518	508	193	329	303	540	232	517	552	516	156	263	516	215	225	-----	200	168
Mar. 17	602	605	475	501	-----	566	60	32	477	368	260	48	519	452	483	472	448	297	501	514	473	532	481	293	343	392	436	479	-----	439	410
Mar. 18	648	604	306	492	-----	582	213	237	545	356	103	577	494	472	71	422	219	510	41	460	42	49	12	165	382	94	229	394	-----	463	224
Means	562	533	422	435	-----	525	269	289	472	320	338	314	410	407	345	378	346	307	374	420	344	403	366	206	334	364	300	393	-----	368	253
Departures	−31	−10	+30	+39	-----	----	----	+3	+64	−40	+17	−13	+42	+5	+62	+48	+74	−31	+56	+116	+42	+92	+63	−26	00	----	+46	+78	-----	+79	−26
Mar. 19	565	480	369	299	-----	536	524	457	73	256	460	268	195	520	568	461	525	457	589	496	568	605	535	216	232	----	272	430	-----	467	235
Mar. 20	682	642	494	510	-----	598	515	533	536	518	451	500	562	294	496	188	542	381	583	464	580	598	522	295	488	508	282	347	-----	374	158
Mar. 21	683	562	522	501	-----	541	450	379	383	465	452	81	313	502	422	506	407	26	460	450	422	434	354	213	302	430	298	243	-----	277	233
Mar. 22	569	511	428	347	-----	601	130	236	256	231	256	78	237	388	331	176	194	318	341	193	389	352	312	142	124	371	119	81	-----	56	(500)
Mar. 23	671	636	457	376	-----	628	309	408	483	355	374	415	267	502	206	103	96	286	102	176	90	82	68	80	165	152	111	339	-----	171	(520)
Mar. 24	705	642	295	260	-----	420	424	465	509	566	436	440	(448)	314	486	193	518	451	526	464	511	537	471	239	233	482	289	407	427	250	440
Mar. 25	681	630	548	532	-----	619	248	346	543	476	78	366	562	488	124	392	115	486	388	397	428	395	349	57	340	277	439	310	384	160	218
Means	651	586	445	404	-----	563	372	403	398	410	358	307	369	430	376	288	342	344	427	375	427	429	373	177	269	----	259	308	-----	251	329
Departures	+28	+14	+3	+8	-----	----	----	+72	−49	+17	+17	−19	−40	00	+44	−42	+28	−37	+29	+44	+82	+55	+56	−102	−121	----	−36	−25	-----	−27	+8
Mar. 26	698	592	466	507	-----	596	373	315	602	583	97	132	398	458	244	416	161	48	349	116	301	373	303	142	396	332	61	67	291	207	163
Mar. 27	622	631	533	516	-----	618	77	114	534	439	336	370	202	395	261	111	188	545	187	314	242	177	107	-----	288	254	190	107	69	120	276
Mar. 28	650	530	348	257	-----	288	300	498	508	610	203	598	(584)	241	(492)	397	359	422	459	539	482	458	427	216	474	228	488	501	334	415	422
Mar. 29	685	622	469	584	-----	605	597	597	640	615	552	573	668	585	(525)	380	524	54	562	544	547	508	495	305	546	533	418	309	460	168	505
Mar. 30	648	647	420	501	-----	590	153	185	423	620	534	257	284	350	390	411	389	131	514	234	426	254	242	87	480	232	259	118	387	161	171
Mar. 31	444	461	470	254	-----	405	406	617	625	629	99	-----	640	612	62	452	78	109	83	88	123	175	202	20	483	162	41	39	390	81	309
Apr. 1	650	586	468	350	-----	652	482	214	636	571	122	-----	639	525	114	398	94	456	376	466	357	415	413	195	508	435	353	550	447	425	358
Means	628	581	453	424	-----	536	341	363	566	581	277	386	488	452	298	366	255	252	361	329	354	346	313	161	454	311	259	242	341	240	372
Departures	+36	+23	−19	+9	-----	----	----	+6	+89	+95	−80	−6	+68	−18	−33	+7	−108	−128	−38	−19	−27	−46	−53	−126	+78	----	−50	−114	-----	−40	+21

ACCUMULATED DEPARTURES ON APRIL 1, 1949

	+273	+63	−2142	−1057	----	----	----	+952	+2912	−70	−1589	−1309	+287	----	+1260	−231	+427	−3227	−952	+497	−1463	−644	−420	−6223	+742	----	−2681	−413	----	−217	+161

TABLE 3.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground, as received on a vertical surface facing south at Blue Hill, Mass., during March 1949*

Date	26	27	28	1	2	3	4	Mean	5	6	7	8	9	10	11	Mean	12	13	14	15	16	17	18	Mean
Gm cal/cm²	28	528	22	63	550	478	516	312	311	160	131	148	488	42	14	185	314	367	503	318	495	468	28	356
Date	19	20	21	22	23	24	25	Mean	26	27	28	29	30	31	1	Mean								
Gm cal/cm²	581	559	364	240	32	436	282	356	251	92	332	419	144	88	262	227								

U. S. GOVERNMENT PRINTING OFFICE: 1949

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, March 1949

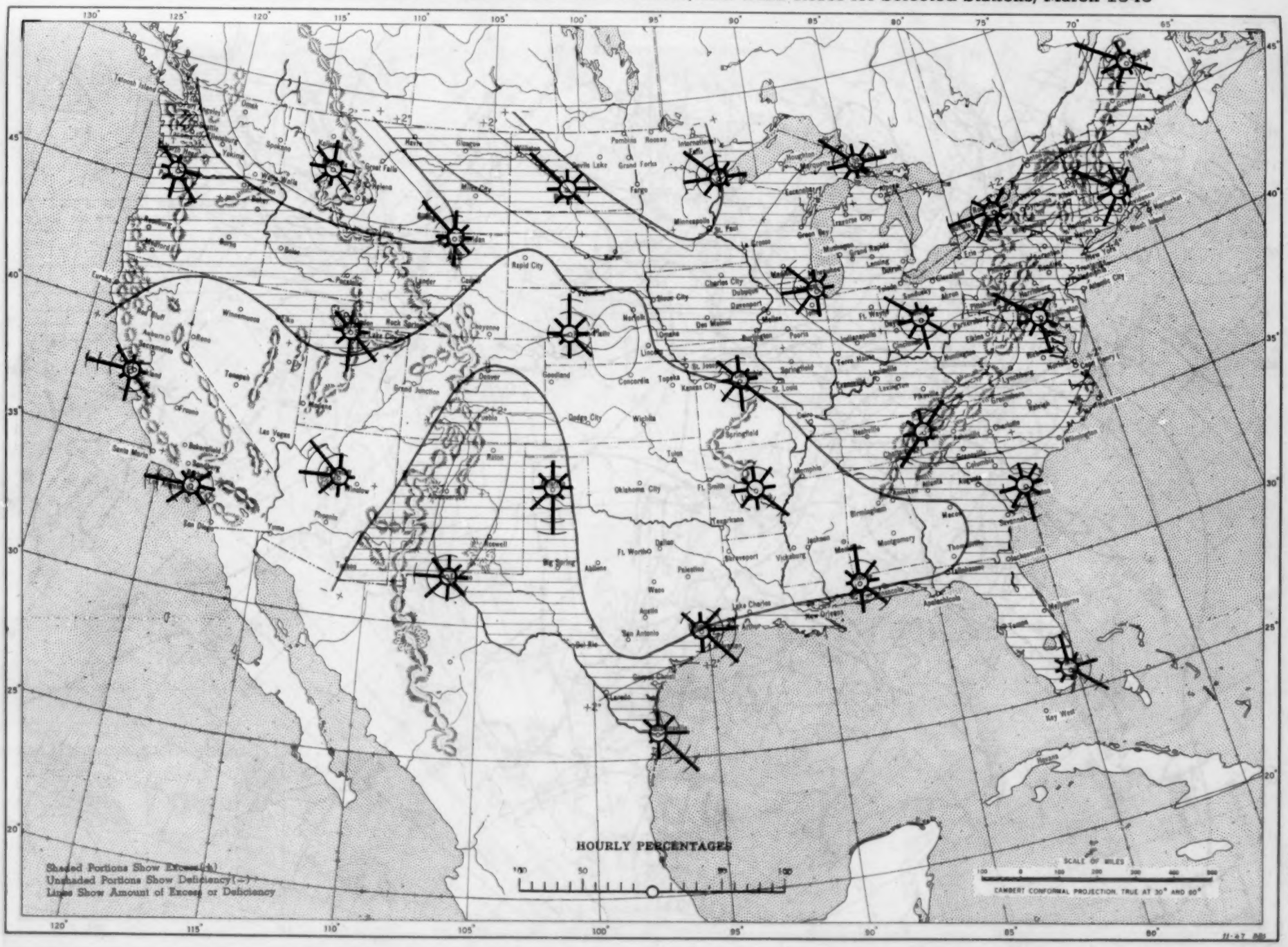
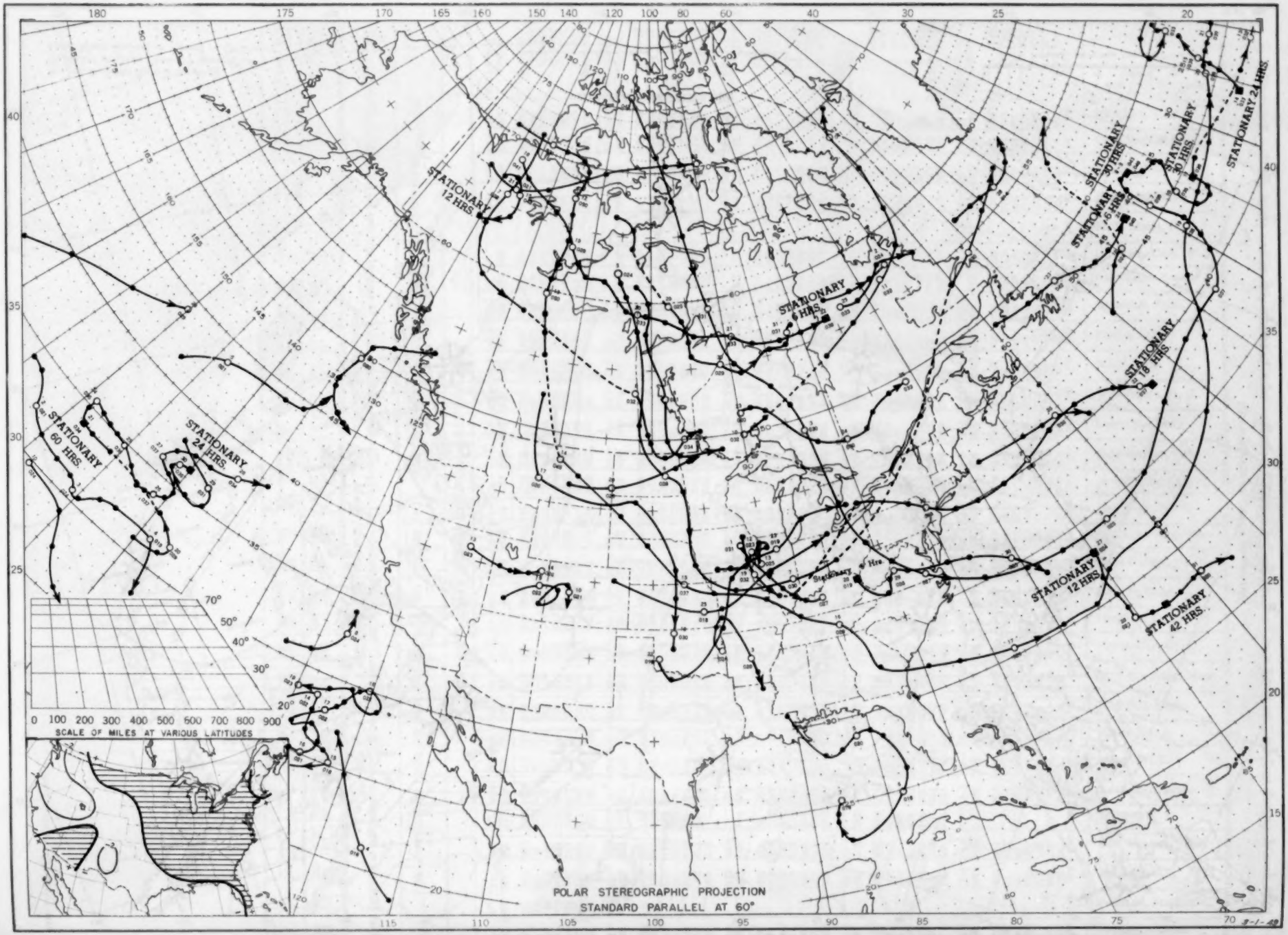

HOURLY PERCENTAGES
50
Shaded Portions Show Excess (+)
Unshaded Portions Show Deficiency (−)
Lines Show Amount of Excess or Deficiency
SCALE OF MILES
CAMBERT CONFORMAL PROJECTION. TRUE AT 30° AND 60°

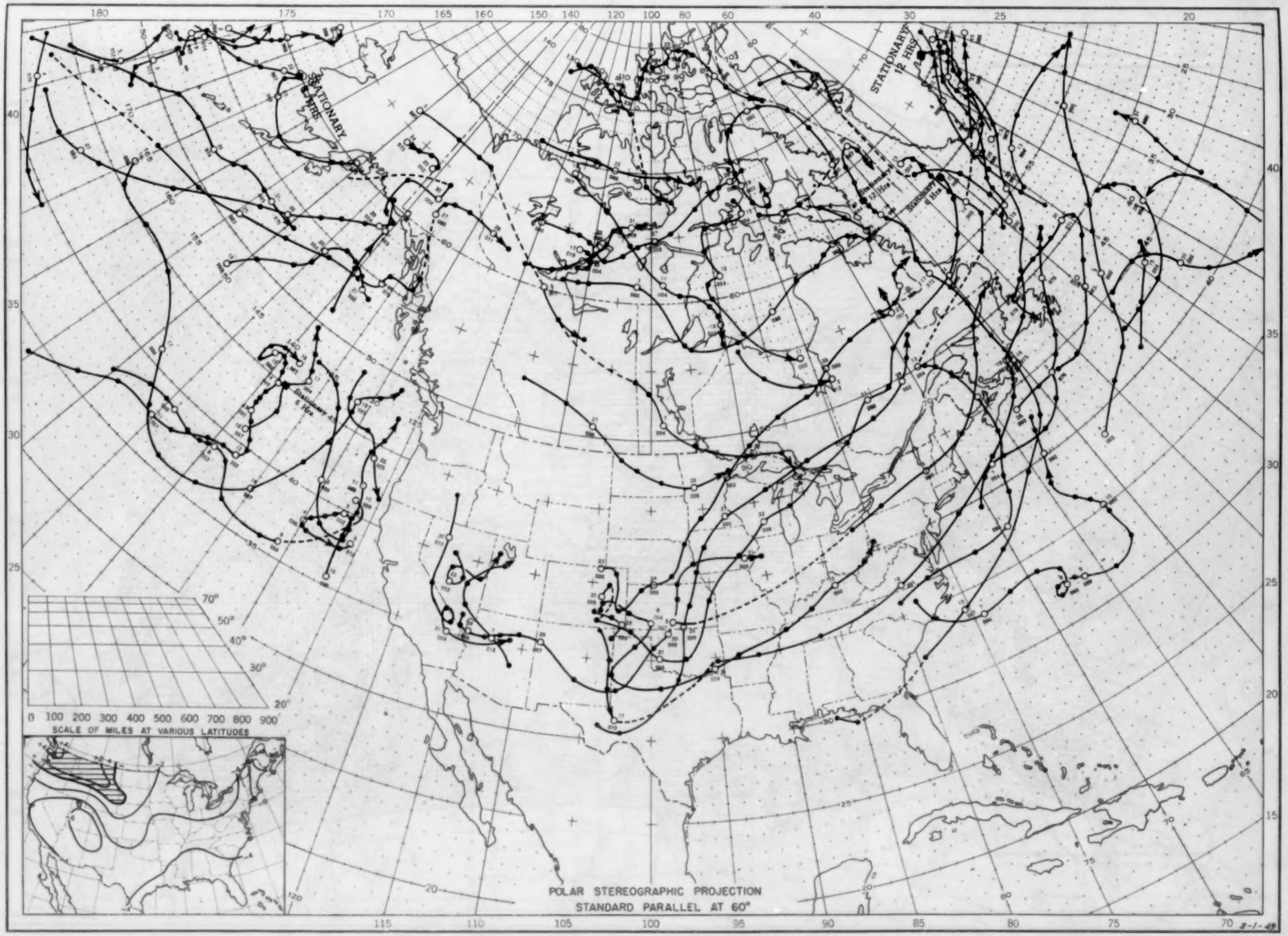
Chart II. Tracks of Centers of Anticyclones, March 1949. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Circle indicates position of cyclone at 7:30 a. m. (75th meridian time) Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart III. Tracks of Centers of Cyclones, March 1949. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time) Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, March 1949

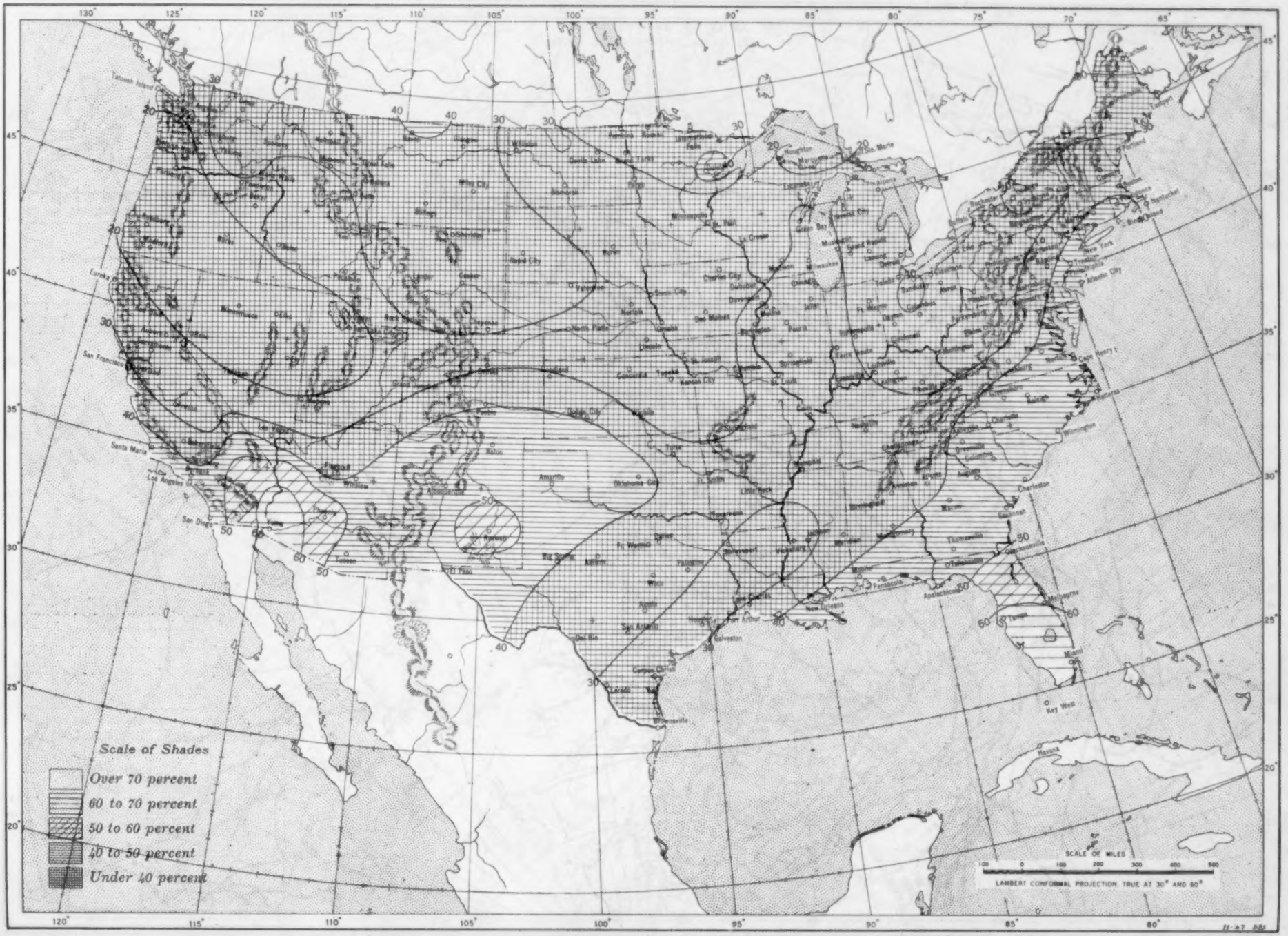

Scale of Shades
Over 70 percent
60 to 70 percent
50 to 60 percent
40 to 50 percent
Under 40 percent
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION, TRUE AT 30° AND 60°

Chart V. Total Precipitation, Inches, March 1949. (Inset) Departure of Precipitation from Normal

Chart V. Total Precipitation, Inches, March 1949. (Inset) Departure of Precipitation from Normal

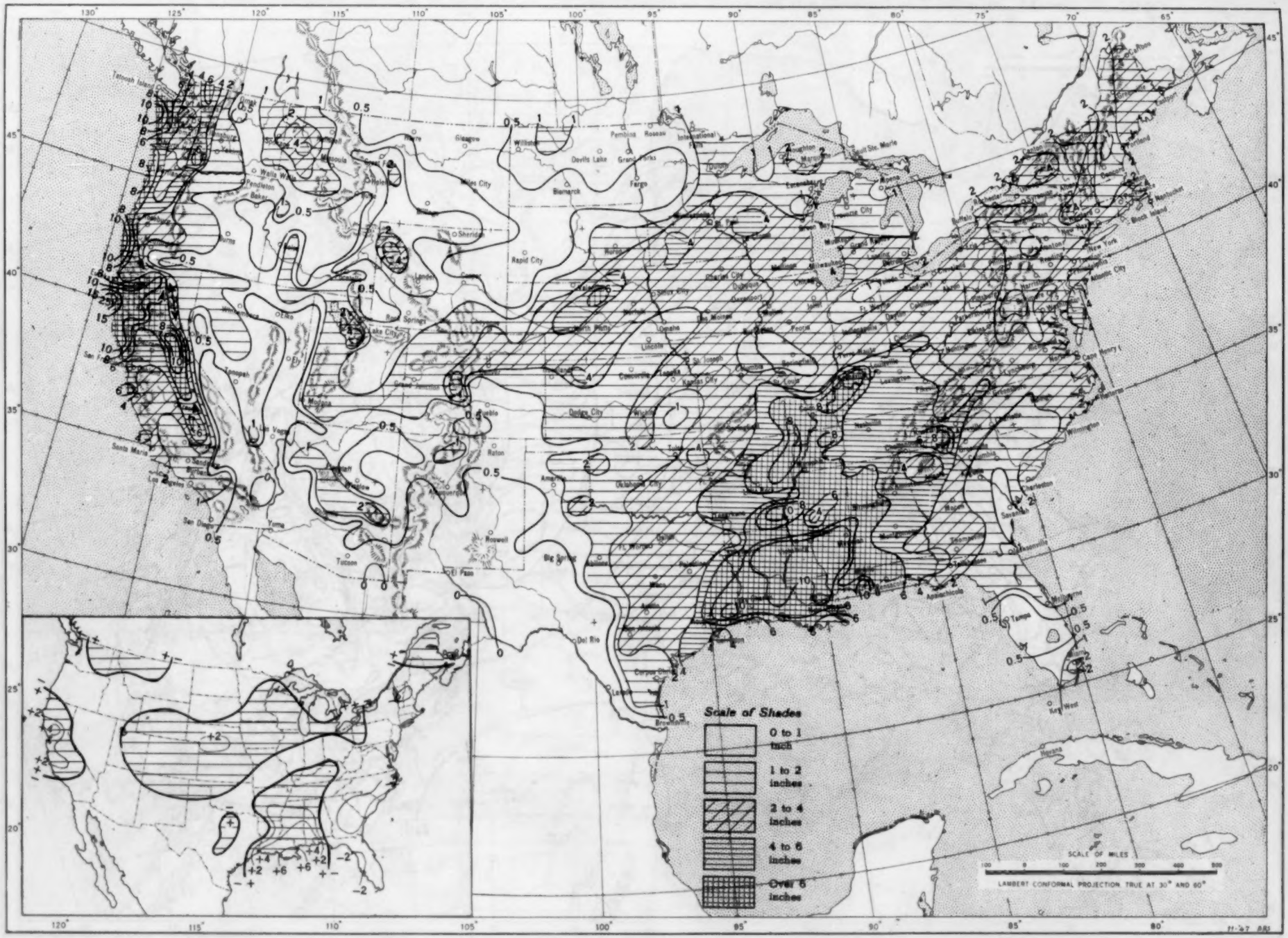

Scale of Shades
0 to 1 inch
1 to 2 inches
2 to 4 inches
4 to 6 inches
Over 6 inches
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION TRUE AT 30° AND 60°

Chart VI. Isobars (mb.) at Sea Level and Isotherms (°F.) at Surface; Prevailing Winds, March 1949

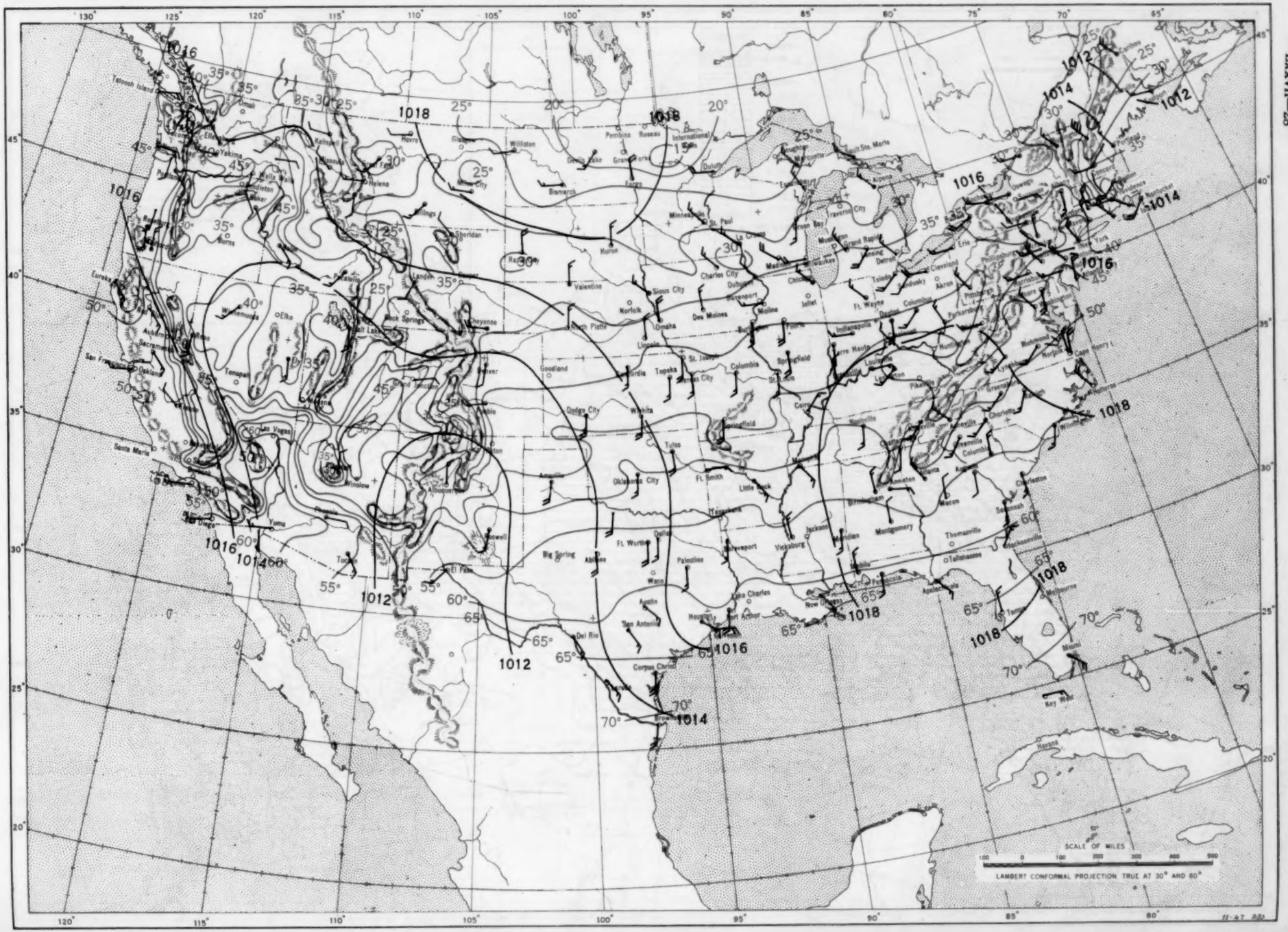


Chart VII. Total Snowfall, Inches, March 1949. (Inset) Depth of Snow on the Ground at 7:30 p. m., March 28, 1949

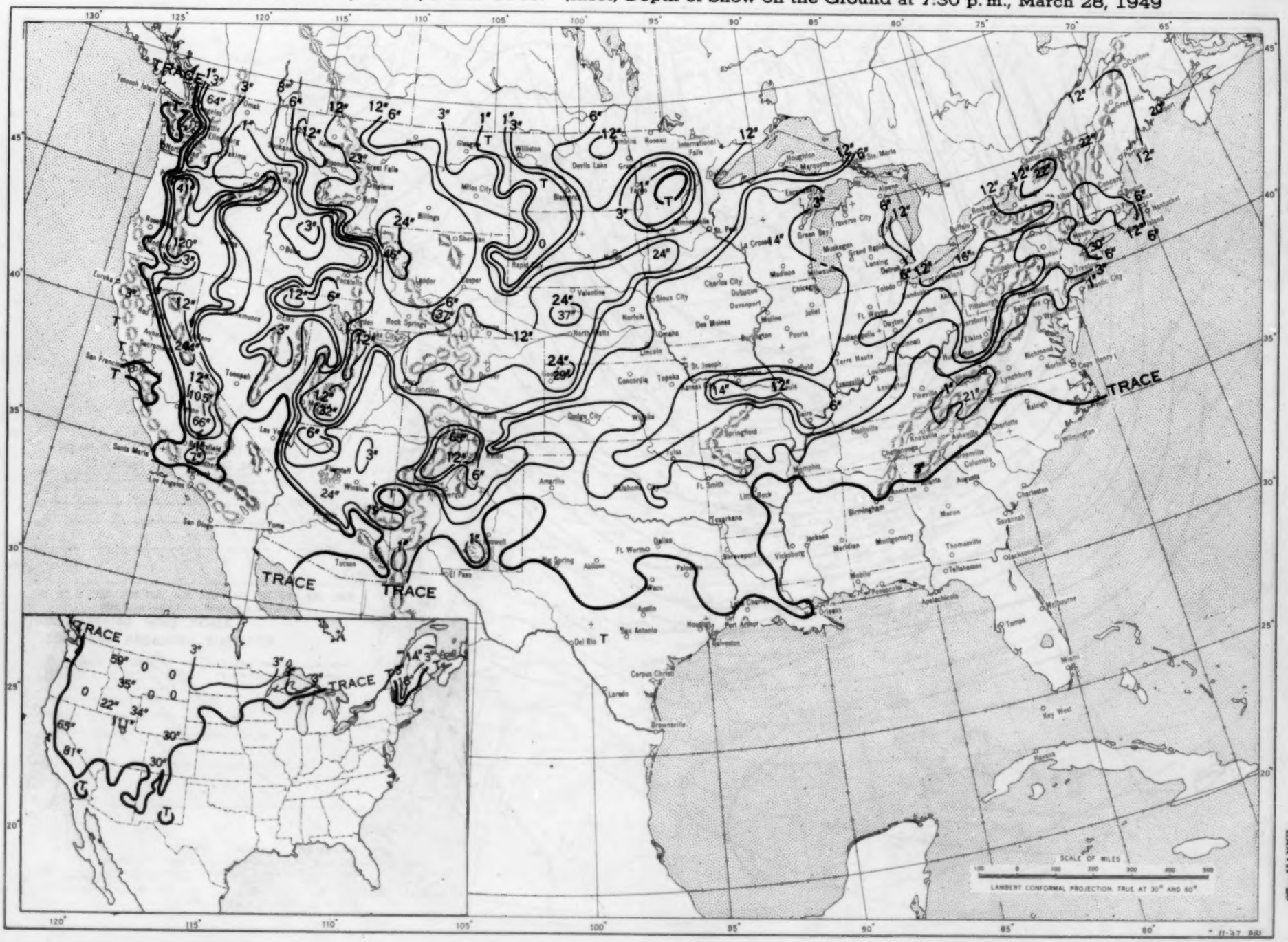
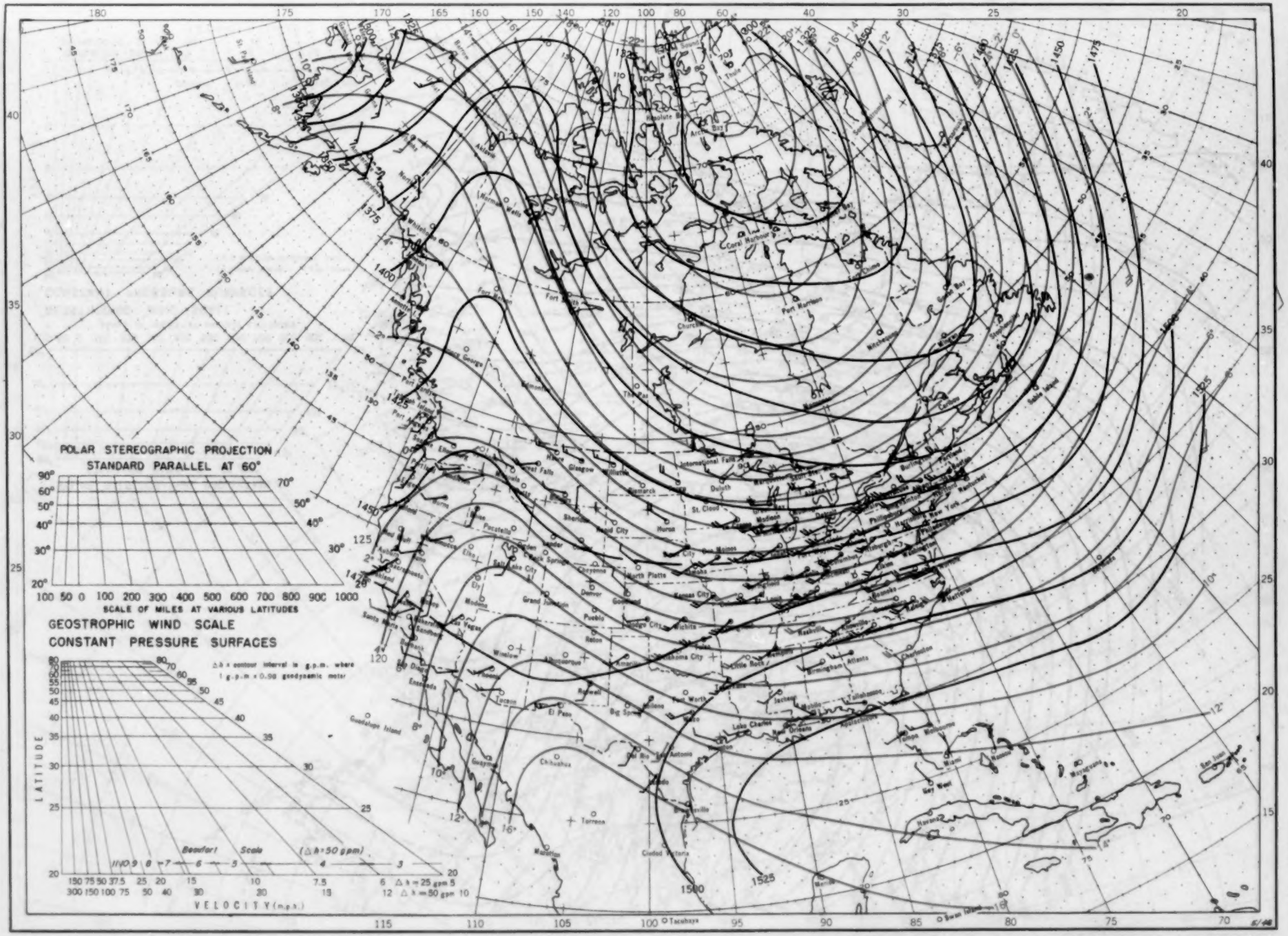


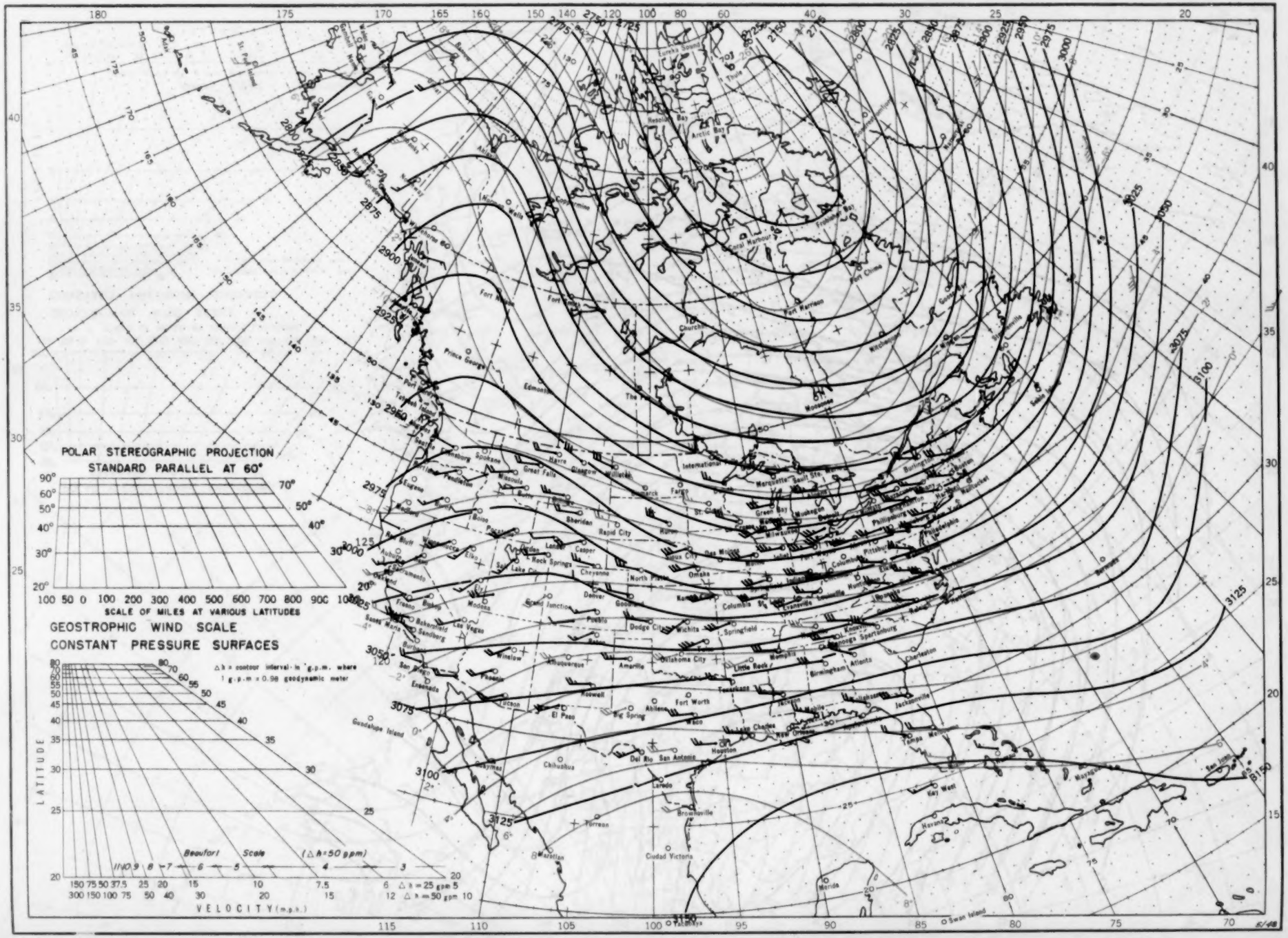
Chart VIII, March 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in

Chart VIII, March 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart IX, March 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)

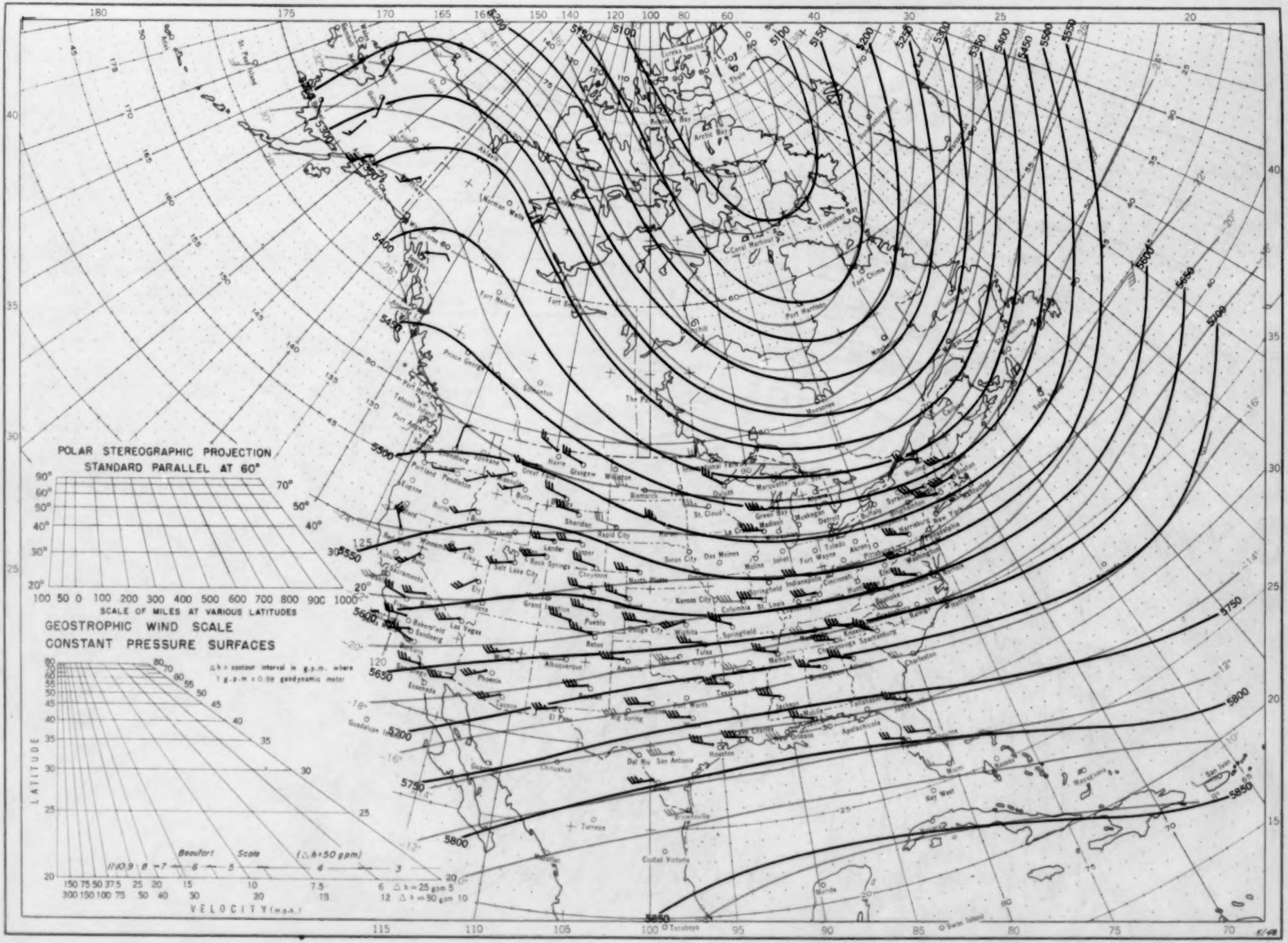

POLAR STEREOGRAPHIC PROJECTION
STANDARD PARALLEL AT 60°
SCALE OF MILES AT VARIOUS LATITUDES
GEOSTROPHIC WIND SCALE
CONSTANT PRESSURE SURFACES
LATITUDE
VELOCITY (m.p.h.)
Beaufort Scale
Δh = contour interval in g.p.m. where 1 g.p.m. = 0.98 geodynamic meter

Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart X, March 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in

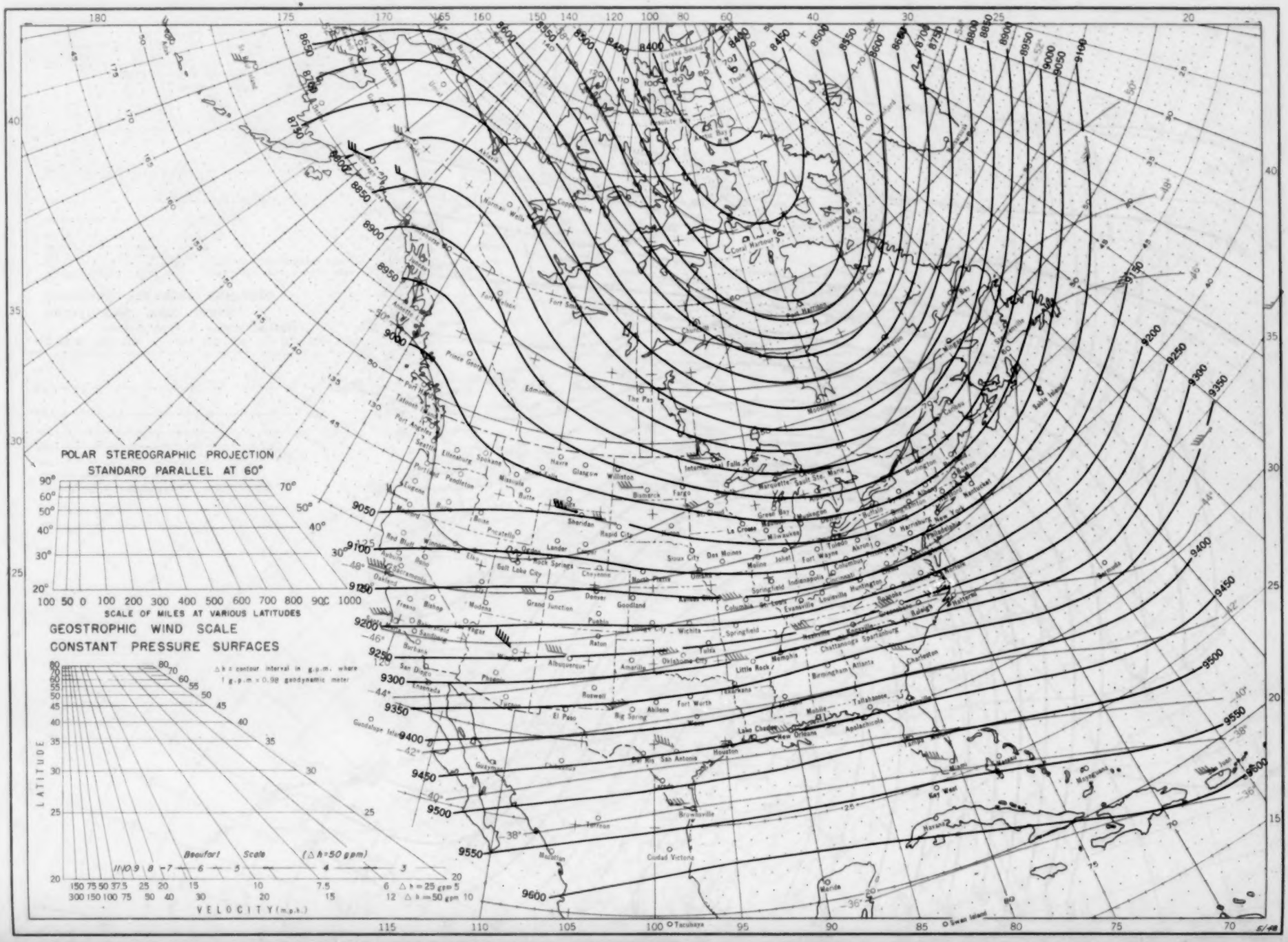
Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at [illegible]
those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart X, March 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, March 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.